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MACHINERY

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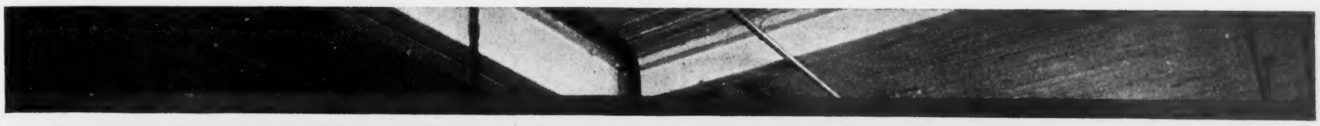
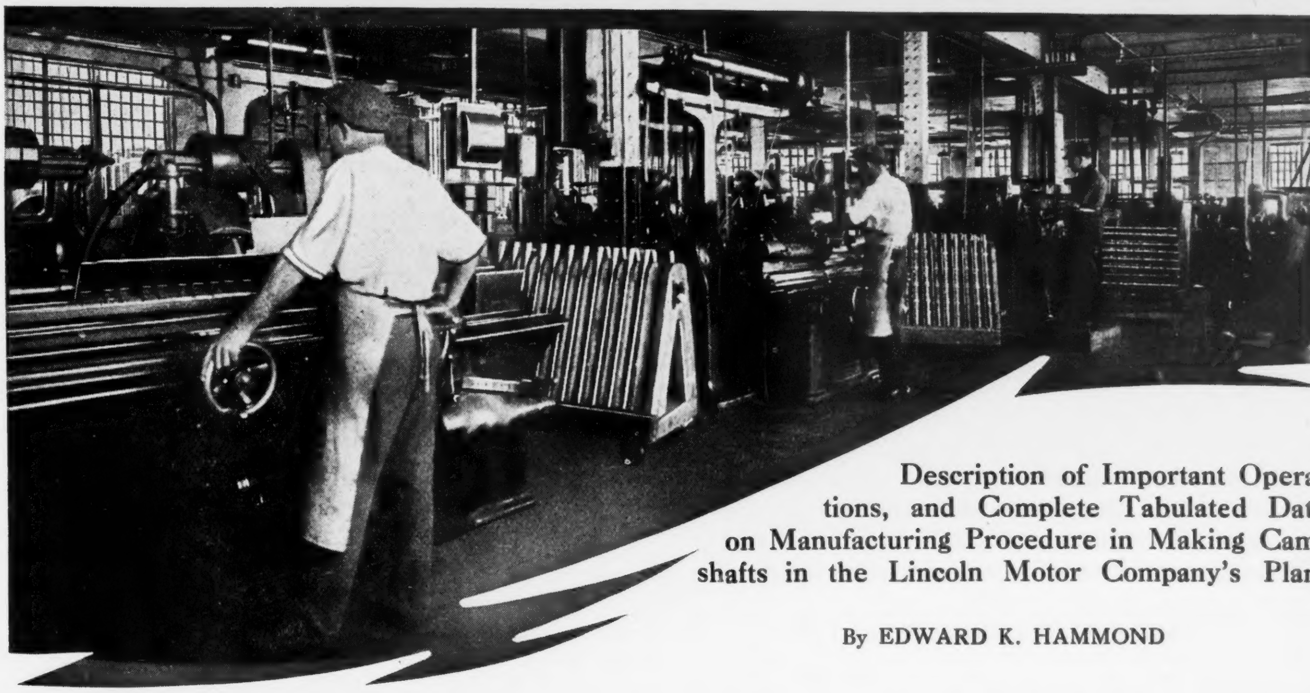


Manufacture of Accurate Camshafts



Description of Important Operations, and Complete Tabulated Data on Manufacturing Procedure in Making Camshafts in the Lincoln Motor Company's Plant

By EDWARD K. HAMMOND

A COMPARISON of methods used in machining corresponding parts of the engine for a high priced automobile, and for one that sells for a lower figure, will frequently reveal the fact that these methods are fundamentally the same in both cases, but that various supplementary operations are interspersed into the schedule of operations followed on the high-priced work. These intermediate steps in the process of manufacture may not appear necessary, but it is the refinements attained through the performance of these additional operations that are responsible for giving to the engine of a high-priced machine its freedom from noise and vibration under normal working conditions. A study of the accompanying table of operations on the camshaft for automobile engines built by the Lincoln Motor Co., in Detroit, Mich., will at once make it apparent that there is considerable duplication in the number of turning, grinding, straightening, and other operations that are performed. However, if an attempt were made to lower the cost of manufacture by reducing the number of turning and grinding operations, etc., there is no doubt that it would be impossible to make camshafts and other parts to the high standards that characterize the work of the Lincoln factory.

Drilling an Axial Hole through the Shaft

It is the practice of the Lincoln plant to use bar steel for camshafts, and to turn the cams and bearings from the solid metal. The blanks used for this purpose come to the camshaft department cut off to a specified length and annealed, so that the steel is in a condition which is favorable for machining. In the accompanying schedule of operations it will be seen that the fifth step in the process of manufacture is to drill an axial hole through the work, 17/32 inch in diameter for a part of the way and 13/16 inch for the remainder of the distance. In connection with the schedule of operations, reference should be made to Fig. 1, which shows a detailed view of the camshaft, the various surfaces to be machined being indicated by reference letters. Fig. 2 illustrates a duplex rifle barrel drilling machine, built by the Diamond Machine Co., Providence, R. I., which is used for these two drilling operations.

During the war period when a number of American plants were engaged in making rifles, MACHINERY

A careful study of manufacturing costs is necessary in striving for accuracy in quantity production. The manufacture of high-grade automobiles presents excellent examples of work of this kind. Accuracy and quality are prime necessities; but quantity production at a reasonable cost is also a commercial requisite, and the best production engineering service, the selection of the best types of machine tools, and the working out of the most suitable methods are of the greatest importance in order that the three factors—accuracy, quantity, and cost—may each receive its proper share of attention. In the manufacture of high-grade automobiles, economical manufacturing methods are just as important as in the making of cheaper cars, because the total number of cars built is less, and the great care used, in conjunction with the additional operations performed, would increase the cost beyond the commercial limits permissible, if the best machines and methods for reducing expenses were not employed.

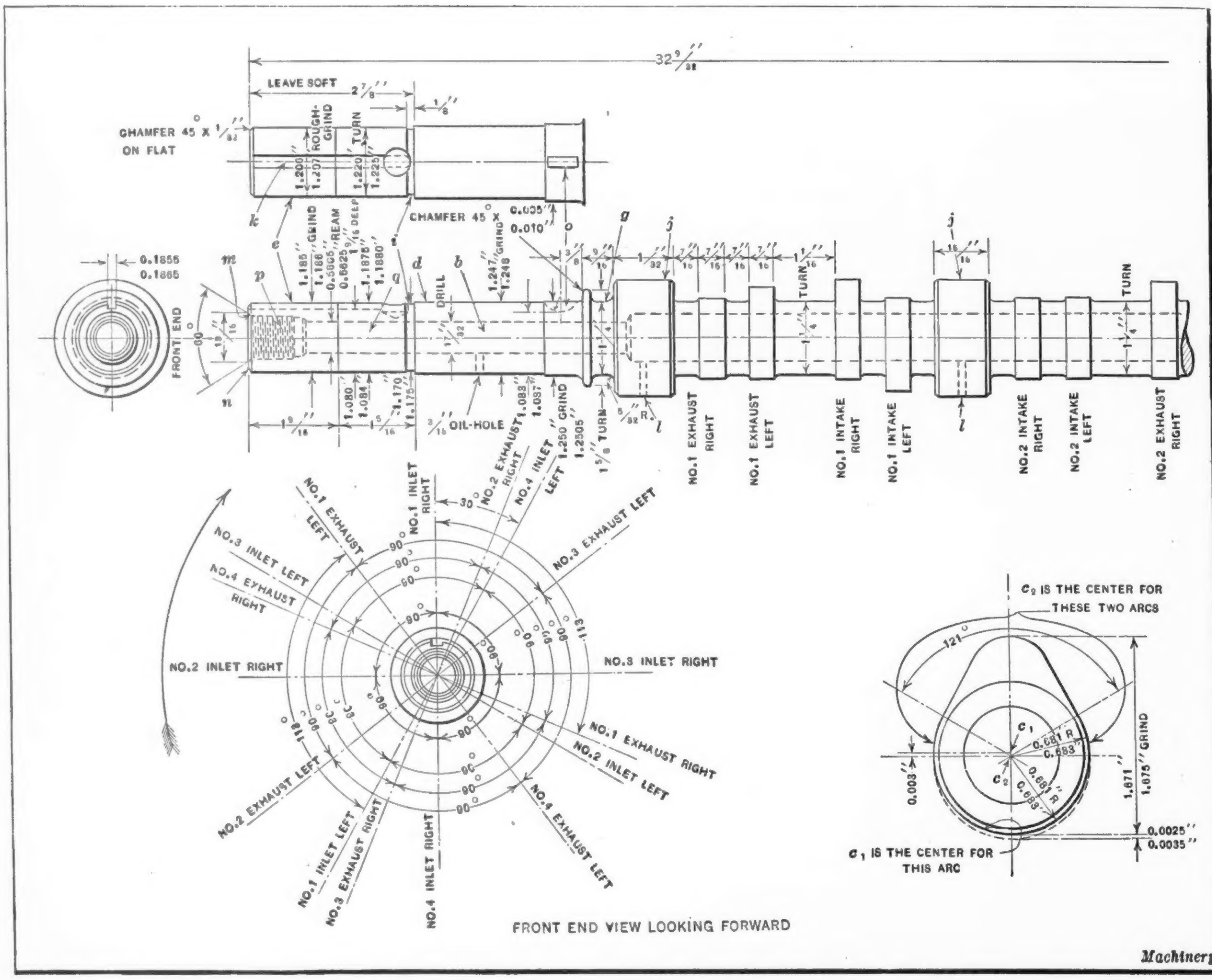


Fig. 1. Detailed View of Camshaft for Automobile Engines made by the Lincoln Motor Co. In Connection with this Illustration Reference

published a complete description of the method of using one of these deep-hole drilling machines. (See MACHINERY, March, 1916.) The drills *A* are of the oil-tube type, and carry oil at high pressure directly to the cutting point, so that the chips are washed out of the deep hole in the work *B* and fall through shields *C* into the pan beneath the machine. On account of the high pressure required to clear the chips from these deep holes, it is necessary to use shields of the kind furnished on this machine, to direct the oil down into the pan, so that it will not spatter over the operator and on the floor.

Turning Spaces between Cams

As will be seen by referring to the detailed view of the Lincoln camshaft, in the illustration Fig. 1, there are five spaces to be turned in machining between each group of four cams. For these operations, a Lo-swing lathe built by the Fitchburg Machine Works, Fitchburg, Mass., is employed, and this machine is equipped with a tool-block that carries five cutter bits, so that the tools may be fed inward to finish all of these surfaces at a single cut. Fig. 4 illustrates one of these machines in operation, and clearly shows the tool-block *A*, the camshaft *B* on which the turning operations are being performed in the spaces between the cams, and the five cutter bits *C* which simultaneously perform these turning operations. Little time is required to position the tool-block and the tools for taking successive cuts. Four settings of the tool-block are required to clean up the areas adjacent to the sixteen cams and the line bearings; and stops are provided on the lathe to facilitate this part of the work.

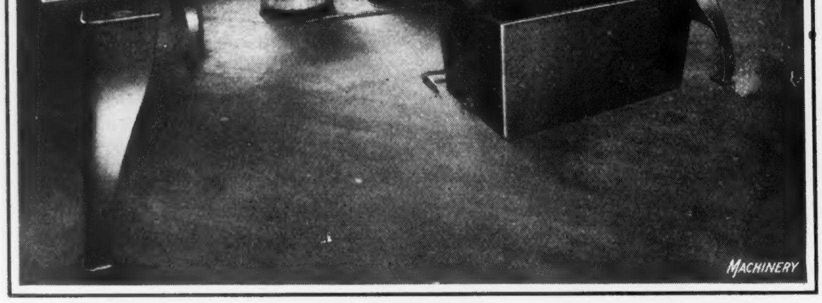
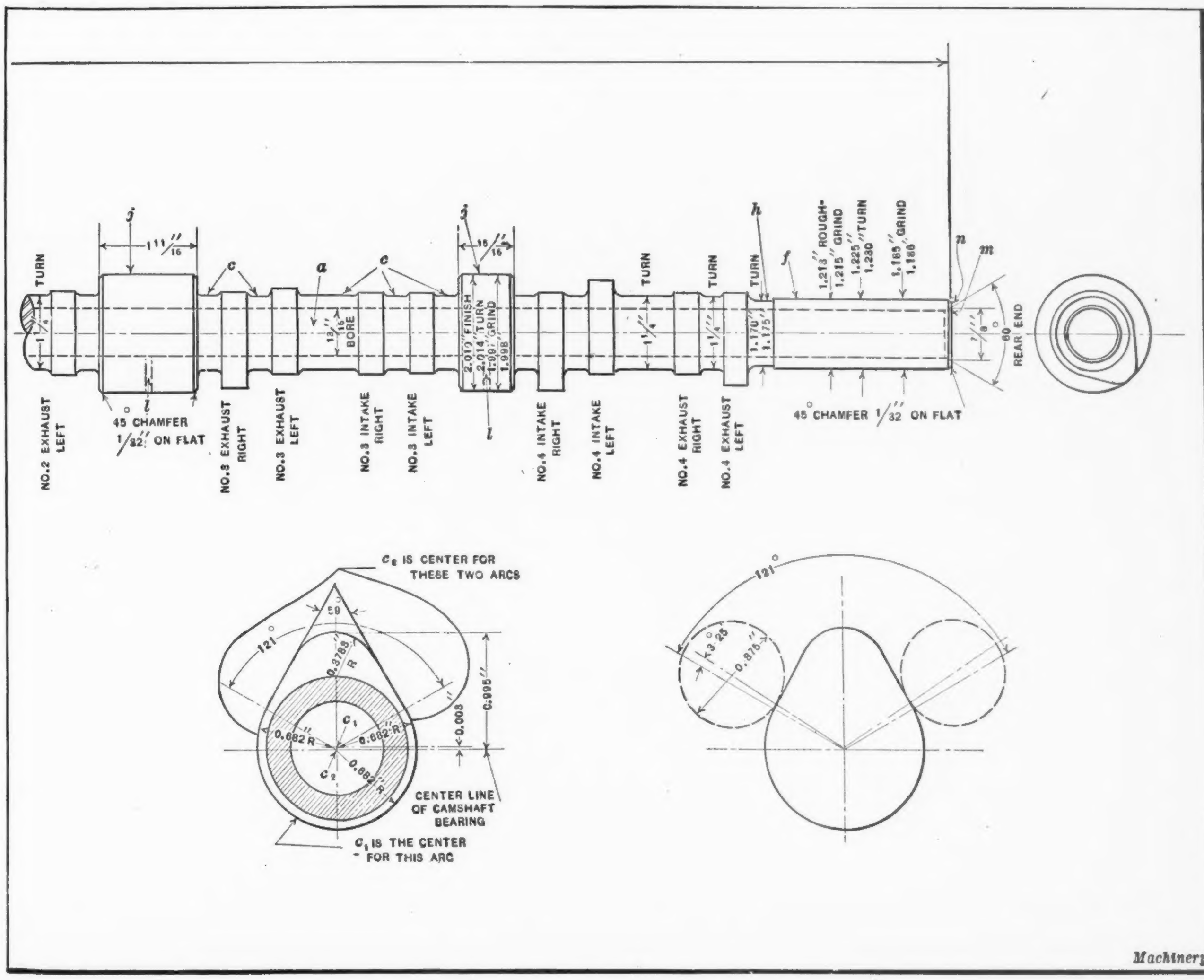


Fig. 2. Duplex Rifle-barrel Drilling Machine used for drilling an Axial Hole through the Rough Steel Bars

Milling the Cams to Form

As the camshafts leave the Lo-swing lathe illustrated in Fig. 4, the cam blanks have been roughed out in so far as the width is concerned, but they are still concentric with the camshaft. Next in the process of manufacture comes the milling of the cams to the required form. On the Lincoln camshafts the cams are concen-



should be made to the Sequence of Operations and Equipment used for machining these Camshafts, as given in the Accompanying Table

tric for 239 degrees, and the rise and fall occur during the remaining 121 degrees; it is obvious that the rise on each cam has to be properly located so that the firing order of successive cylinders will be correct.

Provision has been made for obtaining the required results on a No. 2 plain milling machine built by the Cincinnati Milling Machine Co., which is equipped with a set of 10-inch index-centers made by the Brown & Sharpe Mfg. Co. The machine is shown in operation in Fig. 3. An end milling cutter *A* is mounted in the horizontal spindle of the machine, and in milling each cam *B* to form, the method of procedure is as follows: In the index-plate of the centers are holes for determining the four points at which each successive cam on the shaft must change its form, so that this equipment not only provides for milling all the cams to the proper shape, but also gives them the correct relationship to obtain the proper firing order for the engine. A brief description of the way one cam is milled will make the procedure clear.

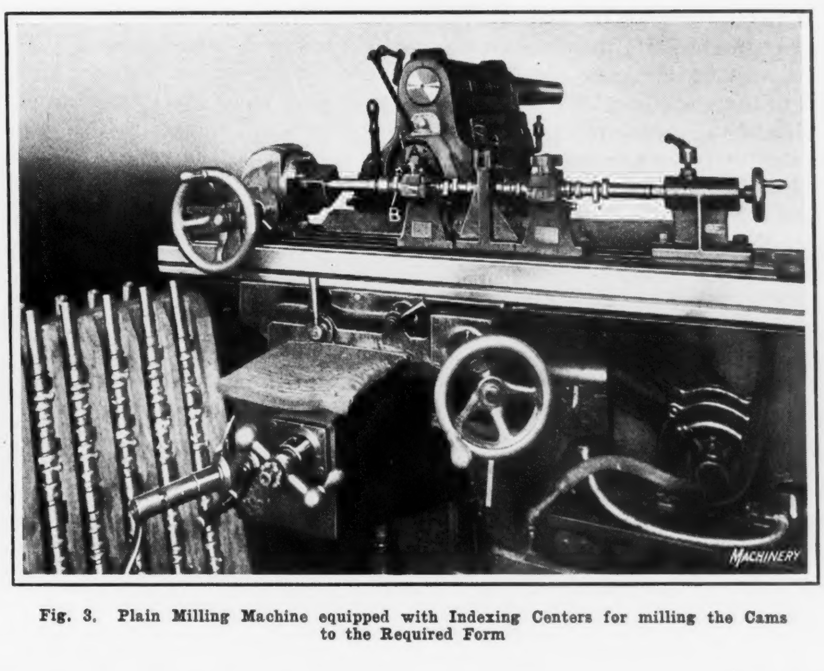


Fig. 3. Plain Milling Machine equipped with Indexing Centers for milling the Cams to the Required Form

It has already been mentioned that the cam is concentric with the shaft through an angle of 239 degrees (see Fig. 1), and for milling this arc, it is merely necessary to rotate the camshaft with the milling cutter in contact with the work. The index-plate on the dividing head determines the starting and stopping points of this concentric portion. Next comes a straight rise on the cam, and to provide for milling this part of the work to shape, rotation of the camshaft is stopped when the index-pin reaches the limiting point, and a vertical feed movement is substituted, so that the work may be fed straight past the cutter. On the milling machine knee, limit stops are furnished to make it a simple matter for the operator to ascertain when he has fed the work the required distance past the cutter in a vertical direction; and upon reaching the second stop, a rotary feed movement of the work is substituted for the straight vertical movement. This rotary movement produces the round top surface of the cam, which is concentric with the shaft.

SEQUENCE OF OPERATIONS AND EQUIPMENT USED FOR MACHINING LINCOLN CAMSHAFTS

Oper. No.	Name of Operation	Type of Machine and Special Tools	Type of Standard Tools
1.	Cut off stock 32⅝ inches long	Newton cold saw	Circular saw blade
2.	Heat-treat	American gas furnace	Bristol pyrometer
3.	Straighten	No. 3A Geier straightening press and roller support for testing trueness	Indicator bracket and No. 5 Ames indicator
4.	Turn both ends to 2 inches diameter by 2.0025 maximum, 1.9975 min., long; face ends to a length of 32 15/32 ins.	Reed 16-inch lathe, steadyrest, and over-all length gage	Cushman three-jaw chuck and Johansson snap gage for 2 ± 0.0025 inch
5.	Drill 13/16 hole a and 17/32 hole b through work (see Fig. 1)	Diamond duplex rifle drilling machine	13/16- and 17/32-inch gun-barrel drills
6.	Center both ends with pilot center	21-inch Cincinnati Bickford upright drilling machine and vertical work-holding fixture	Wiard chuck, 60-degree center drill and 13/16- and 17/32-inch pilot for the center drill
7.	Rough-turn balance of shaft to 2 3/64 inches diameter	3½-inch Lo-swing lathe and roller rest	Driving dog and tool-holder
8.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
9.	Grind turned diameter 2.045 min., 2.050 max.	Norton 10- by 36-inch cylindrical grinding machine	Johansson snap gage, and driving dog
10.	Rough spaces c between cams and adjacent to bearings, leaving 1/32 inch of stock	8-inch Lo-swing lathe, steadyrest, tool-block, and tool spacing gage	Driving dog and snap gage
11.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
12.	Finish-turn spaces c between cams	8-inch Lo-swing lathe, tool-block holding five necking tools, tool spacing gage	Snap gages for diameter, width, and spacing of cam blanks
13.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
14.	Rough-turn front end diameters d and e to 1 11/16 and 1⅝; also rough-turn rear end diameter f to 1 5/16 inch	18-inch Reed engine lathe	Armstrong tool-holder, snap gages, and driving dog
15.	Turn recess g to 1¼ diameter by 5/32 inch radius, and recess h to 1.170 min., 1.175 max., diameter	3½-inch Lo-swing lathe	Gages, driving dog, and turning tools
16.	Turn front end e to 1.225 max., 1.220 min., and recess i to 1.175 max., 1.170 min., by ⅛ inch wide	Leland-Gifford 15-inch lathe	Snap gages and Armstrong tool-holders
17.	Turn rear end f to 1.230 max., 1.225 min., diameter by 3 5/16 inches long	Reed 18-inch lathe	Driving dog, Armstrong tool-holder, Johansson snap gages
18.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames dial indicator
19.	Rough-grind line bearings j to 2.030 min., 2.032 max.; front end diameter e to 1.206 min., 1.207 maximum; diameter d to 1.285 min., 1.287 max.; and rear end diameter f to 1.213 min., 1.215 max.	10- by 36-inch Norton cylindrical grinding machine	Johansson limit snap gages and driving dog
20.	Rough-mill keyway k to 0.170 max., 0.165 min., in width, and burr	Pratt & Whitney spline milling machine, keyway milling fixture, tool setting gage	Two-lipped fish-tail cutter and gages
21.	Mill cams to form	No. 2 Cincinnati milling machine	Brown & Sharpe 10-inch plain index-head and center, Johansson snap gages and end milling cutter
22.	Chamfer bearings and burr all over	Reed engine lathe	Flat files, driving dog and steadyrest
23.	Inspect		Gages for all dimensions
24.	Copperplate 0.005 to 0.008 inch thick—Inspect	Electroplating bath and rack for holding in copperplating bath	
25.	Recenter ends		

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Rotary feed movement is again stopped when the index-pin of the dividing head drops into its next hole in the plate, and a vertical downward movement of the knee is substituted for the rotary feed, until the lower stop is reached, which limits this vertical movement. At this point, the cutter has returned to the position where it started to mill the concentric portion of the cam over an angle of 239 degrees, and this completes the cycle of operations. Then, the work is withdrawn from the milling cutter, and rotated until the index-pin enters the next hole in the plate. This rotates the camshaft into the proper position to start milling the 239-degree concentric portion of the next cam, after the work has been traversed longitudinally to bring the next cam blank opposite the milling cutter. When this has been done, the machine is again set in motion. By repeating this cycle of operations sixteen times, all the cams on the shaft are milled to shape.

Grinding the Cams

After roughing out the cams to the required form by milling, as just described, the work goes to a Norton 10- by 50-inch cam grinding machine for the first grinding operation. The machine is shown in operation in Fig. 7. It is provided with the usual arrangement for rocking the work as it rotates in contact with the grinding wheel, this oscillation being accomplished by means of a master cam which is of the same form as the cams to be ground. Hence, it is a simple matter to perform this cam grinding operation in accordance with standard practice. It will be apparent that for performing this cam grinding operation, the master cam must be an exact duplicate of the cams on the camshaft in the form they have reached after the first grinding operation. This is true both as regards the allowance for metal to be removed by subsequent grinding, and the angular positions of the cams around the shaft, in order to give exactly the proper firing order for the engine cylinders.

Testing Hardness of Cams and Bearings

All cams and bearings of the Lincoln camshaft are hardened, and as the finished shafts go to the inspection department, the first step is to test the hardness of these members with a Shore scleroscope *A*, Fig. 5. This instrument is mounted on a special machine which holds the camshaft on a table *B* that may be moved longitudinally under the scleroscope, so that a minimum amount of time is required to bring successive cams and bearings into position for making the hardness test. This is a typical example of the usefulness of the scleroscope in testing a finished product, as it enables an accurate determination of hardness to be made without damaging the finish of the surface.

SEQUENCE OF OPERATIONS AND EQUIPMENT USED FOR MACHINING LINCOLN CAMSHAFTS

Oper. No.	Name of Operation	Type of Machine and Special Tools	Type of Standard Tools
26.	Grind copper off line bearings j to a diameter of 2.018 min., 2.020 max.; rear bearing f to a diameter of 1.203 min., 1.205 max.; and front bearing d to a diameter of 1.265 min., 1.268 max.	20- by 36-inch Norton cylindrical grinding machine	Johansson snap gages and driving dog
27.	Grind copper off cams to a diameter of 1.378 min., 1.382 max.	Norton 10- by 50-inch cam grinding machine	Norton master cam, grinding wheel and Johansson snap gage
28.	Drill 3/32-inch oil-holes l in bearings j	Leland - Gifford sensitive drilling machine and jig	Jacobs drill chuck, twist drills, and countersinks
29.	Inspect	Over-all length gage	Johansson snap gages
30.	Carburize	Carburizing tubes	
31.	Clean centers m and straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames indicator
32.	Face and chamfer ends n to 32 9/32 inches long. Recenter both ends and turn Woodruff keyseat bearing o to 1.265 min., 1.268 max., diameter	Reed 16-inch lathe	Gages and Armstrong tool-holder
33.	Inspect	Special gaging machine	Johansson snap gage
34.	Sand-blast	Pangborn sand-blasting machine	
35.	Harden	American gas furnace	Bristol pyrometer
36.	Draw temper	Cyanide bath	Bristol pyrometer
37.	Sand-blast outside	Pangborn sand-blasting machine	
38.	Sand-blast hole	Pangborn sand-blasting machine	
39.	Inspect for hardness		File
40.	Straighten	No. 3A Geier straightening press	Indicator bracket and No. 5 Ames dial indicator
41.	Inspect location of cams	Special testing machine	Ames No. 5 dial test indicators
42.	Rough - grind line bearings j, and front and rear bearings d and f	Norton 10- by 36-inch cylindrical grinding machine and back-rest	Johansson snap gages and driving dog
43.	Drill and tap hole p, ream hole q, and counterbore	Cincinnati Bickford drilling machine. Vertical work-holding fixture	Wiard quick - change chuck, drill, tap, reamer, and counterbore
44.	Recenter	Reed 18-inch lathe	Armstrong tool-holder, and driving dog
45.	Finish-mill keyway k to 0.1855 min., 0.1865 max., in width	Pratt & Whitney spline milling machine and keyway milling fixture	Two - lipped fish - tail milling cutter and gages
46.	Mill Woodruff keyseat o	No. 6 Whitney hand milling machine and work-holding fixture	Woodruff keyway cutter and holder, and gages
47.	Grind line bearings j to 1.999 min., 2.000 max., diam.	10- by 36-inch Norton cylindrical grinding machine	Johansson tolerance snap gage and driving dog
48.	Grind cams to 1.367 min., 1.368 max., diameter	Norton 10- by 50-inch cam grinding machine	Johansson tolerance snap gages, Norton master cams and rollers
49.	Finish - grind cams to 1.366 max., 1.3655 min., diam.	Norton 10- by 50-inch cam grinding machine	Norton master cams and rollers. Johansson snap gages
50.	Finish - grind line bearings j to 1.998 max., 1.997 min. diameter; front bearing d to 1.248 max., 1.247 min. diameter; Woodruff keyseat bearing o to 1.2505 max., 1.250 min. diameter; front end e to 1.1880 max., 1.1875 min. diameter for 1 5/16 inches, and to 1.1860 max. 1.1850 min. diameter for balance of length; finish-grind rear bearing f to 1.186 max., 1.185 min. diameter.	Norton 10- by 36-inch cylindrical grinding machine	Tolerance snap gages and driving dog
51.	Stone off sharp corners on cams, and burr	Blount 11-inch speed lathe	Carborundum oilstone and driving dog
52.	Hand tap	Bench fixture	No. 4 Bay State tap wrench and tap and limit thread plug gages
53.	Inspect	Machines for testing opening and closing points of cams, and concentricity and spacing of cams and bearings	Johansson tolerance snap gages
54.	Test hardness	Shore scleroscope	

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Testing Concentricity and Spacing of Cams and Bearings

For testing the concentricity of the four line bearings, and of the two bearing diameters at the front end of the shaft, use is made of six dial test indicators mounted on the fixture illustrated in Fig. 6. The work is carried on supports which allow it to be rotated with the bearings in contact with the plungers of the dial indicators. If the needles of any of these instruments indicate an error of more than 0.001 inch, the work is sent back to the machine shop for correction or else it is discarded, according to the seriousness of the conditions which are discovered. On this testing fixture, there is also a spacing gage-bar *A* at the opposite side of the work from the dial indicators. This gage has spaces machined in it to receive each of the cams and line bearings, so that if there is any error in the longitudinal spacing of these members, it will be impossible to place the work in the gage.

Ascertaining the Accuracy of the Intake and Exhaust Points on the Cams

In connection with the preceding description of the method used for rough-milling the cams, mention was made of the importance of locating each cam accurately on the shaft, so that the firing order of the engine cylinders would be accurate. Obviously this is a most important point, and great care must be taken in inspecting the finished camshafts to make sure that these points on the cams have all been correctly located. For this purpose, use is made of an inspection fixture which is shown in use in Fig. 8. This consists of a dial test indicator, carried by a bracket *A* which is free to slide along a bar *B* at the rear of the fixture.

In this way, it is an easy matter to bring the plunger of the indicator into successive contact with each cam; after a plug *C* at the front of swinging bracket *A* has been brought down into contact with a corresponding block *D* mounted on the front of the fixture frame, the indicator dial is set to zero, with the plunger in contact with the 239-degree concentric portion of the cam. Then the camshaft is rotated until the indicator plunger comes sufficiently beyond the extreme of this concentric portion to deflect the needle over a 0.001-inch space, after which the inspector observes the position of a fixed index mark on bracket *E* relative to two limit marks scribed on the rim of a wheel *F* that is turned with the camshaft. This wheel is keyed to the camshaft, so that a definite relationship always exists between the position of the opening or closing point on each cam and the corresponding graduations on the rim of the wheel.

There are thirty-two sets of graduations around the wheel *F*, which indicate the limiting positions for the sixteen cams that actuate the opening and the closing of the intake and

of the exhaust valves for the eight cylinders. When the dial indicator needle has been deflected over a 0.001-inch space in the manner previously described, the fixed graduation at *E* must lie between the two limit graduations on wheel *F* for that point on the cam. Then the inspector turns the wheel *F* in the opposite direction until the indicator needle is again deflected over a 0.001-inch space, and observes whether the fixed graduation at *E* lies between the two limit graduations on the rim of the wheel. After making this test, the bracket *A* is moved along bar *B* to bring the plug *C* into contact with the next plug *D*, after which the test is repeated for the next cam. This cycle of movements is gone through sixteen times, in order to test the opening and closing points of each of the cams on the shaft. The method is one which enables extremely accurate determinations to be accomplished with a minimum expenditure of time.

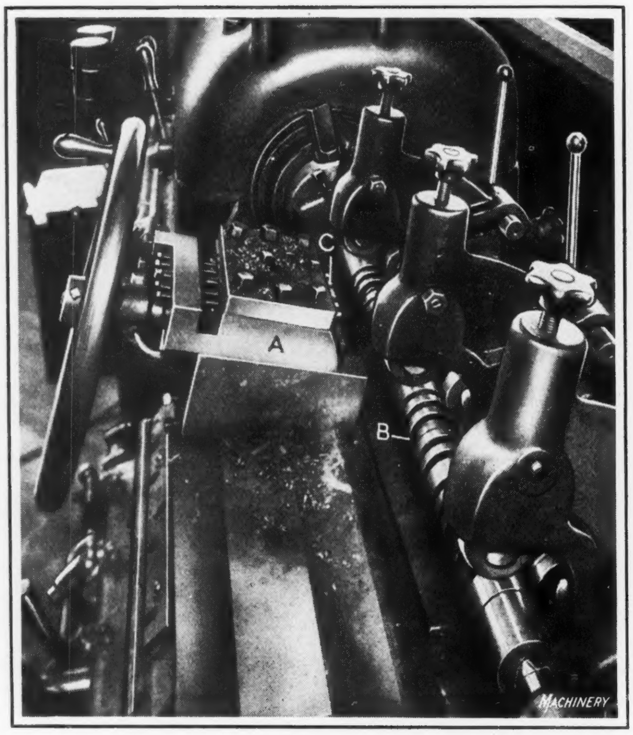

Fig. 4. Spacing the Cams and Line Bearings on a Lo-swing Lathe

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DEMAND FOR LOW-COST GARAGE MACHINERY

By J. ARTHUR GLATTLY

The whole trend in machine tool design has been toward the production of machinery that would perform a large amount of work in a minimum of time. It is the writer's belief that there is now a large potential field for machine tools designed along somewhat different lines. This field includes machines that are low in initial cost, but which nevertheless should have capacity for a wide range of work. Machine tools of this class have received comparatively little consideration. In making this statement the writer has in mind the requirements of small repair shops and garages. There are about nine million automobiles and trucks in use in the United States today, and every one of these requires more or less maintenance work. Many of these automobiles were built by companies no longer in existence, and it is often difficult and usually requires considerable time to obtain replacement parts for them.

Machines for Regrinding Cylinders

The matter of regrinding cylinders is an important one. It is necessary to regrind the cylinders at least once during the life of the average car if satisfactory operation is to be maintained. Regarding cylinder grinding machinery, there is little to be desired in the way of improvements in the standard machines now on the market, so far as accuracy or production is concerned, but the average price of these machines is somewhat high for small garages or repair shops. What is needed is a machine that will handle a large variety of cylinders the first cost of which will be within the reach of the man who owns a small garage and who has a limited amount of this work to do, but who cannot afford to make a heavy initial investment for what may be termed a standard machine. A machine to meet these requirements need not be capable of high production rates. There are many devices for reboring cylinders, but reboring does not give the desired finish. The writer believes that a regrinding machine that would cost, say, about $500 to $800 would have a vast potential market.

Milling Machine Developments

In regard to milling machines the same condition obtains as in the case of grinding machines. No heavy initial expenditure in tool equipment, however, need be made if fly cutters are used in place of milling cutters. There is no reason why some of the lighter types of hand milling machines could not be equipped with table feeds at no great

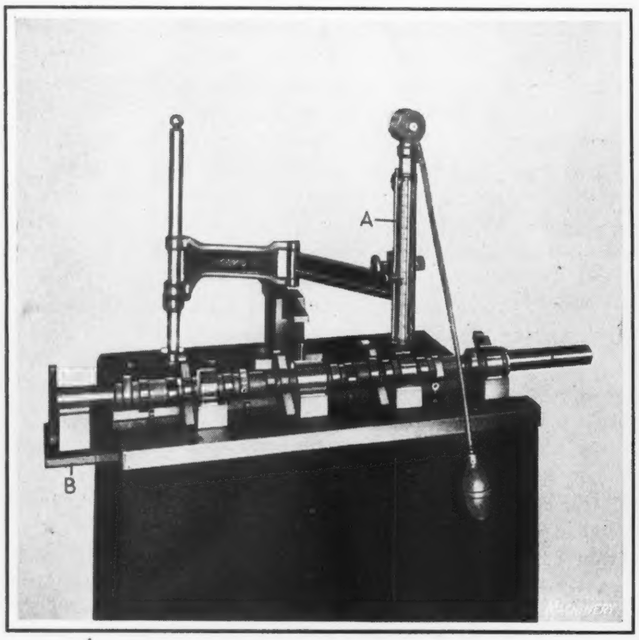

Fig. 5. Testing the Hardness of the Ground Cams and Bearings with a Scleroscope

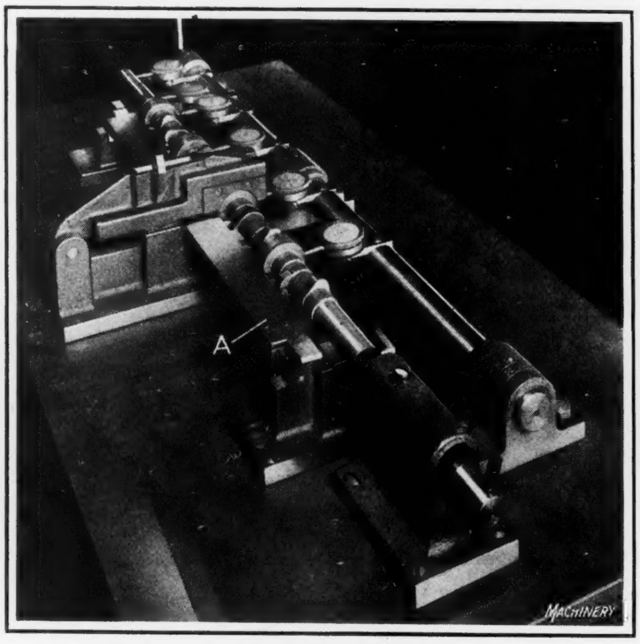

Fig. 6. Testing Spacing of Cams and Bearings, and Concentricity of Bearings

additional cost. By the use of fly cutters, machines so equipped would be capable of handling a wide range of work. In fact, the writer believes that the possibilities of the fly cutter are overlooked to a great extent at the present time in our large shops and tool-rooms. For the small shop, however, the possibilities of the fly cutter are almost limitless.

With the development of the electric furnace and electrical temperature recording instruments, the problem of heat-treating small quantities of gears has become a simple matter. The time is not far distant when there will be many shops throughout the country which will be equipped to replace gears for automobiles made by companies no longer in business.

Improvements in Drilling Machines

In regard to drilling machines the writer believes that there is room for development, notwithstanding what has already been accomplished along these lines. For a small shop there is need of a drilling machine that has a wide range of speeds and feeds and one which has simple provision for taking up the lost motion in the spindle bearing. A taper roller bearing would, the writer believes, make adequate provision for spindle bearing adjustment.

The small shop owner cannot afford several drilling machines, and it is therefore necessary that he have a machine which will be capable of handling all sizes of drills, from the small "numbered" drills up to the large sizes having taper shanks. It should be borne in mind that a drilling machine in a small shop can be used to good advantage on many boring jobs, but at the same time it must be remembered that the cost should be kept as low as possible and the machine made as simple as is consistent with the work it is intended for. In regard to lathes and external grinding machinery, the writer believes that the possibilities of design, as far as the needs of the small shop are concerned, have been well covered.

A well-equipped machine shop will become more and more a necessary adjunct to every first-class garage. This shop will be successful in handling its work just as soon as machine tool builders develop and produce a line of machinery which is adapted especially to the peculiar needs of the garage and the small repair shop.

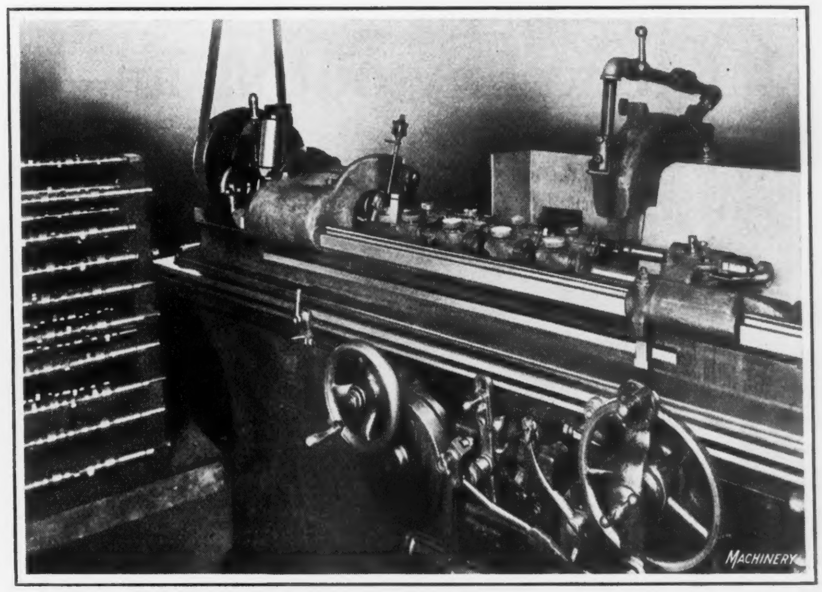

Fig. 7. Camshaft Grinding Machine

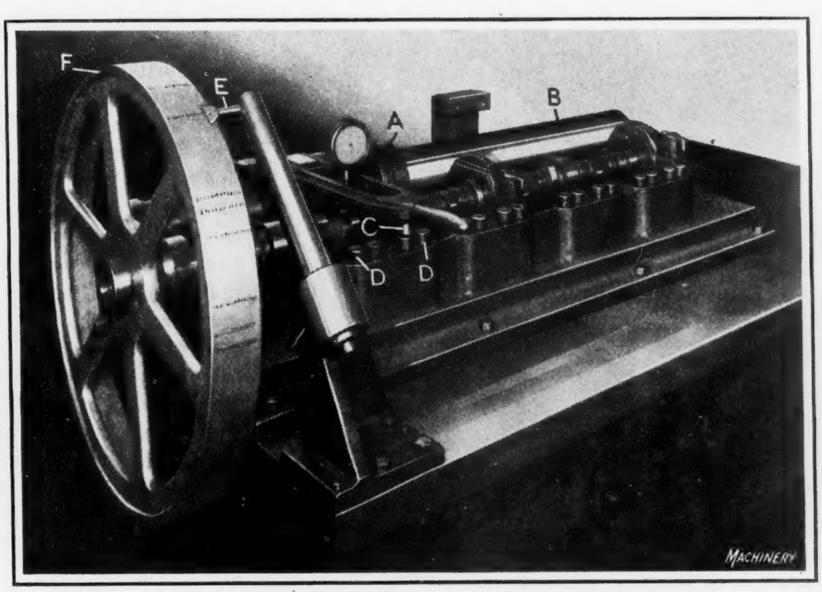

Fig. 8. Special Testing Machine used for determining the Accuracy of the Intake and Exhaust Points on all Cams on the Shaft

COURSE IN INDUSTRIAL PUBLISHING

At its September meeting, the New York Business Publishers Association announced the establishment of a course in industrial publishing. The course has been organized and will be conducted under the direction of the educational committee of the association by the Business Training Corporation, which has been retained for that purpose. It will include lectures, conferences, text-books, problems, and a personal commenting service. Classes are now being organized in New York and will soon be organized in other publishing centers. The course will also be conducted by correspondence for people who are unable to attend classes. Although designed primarily for the benefit of members of the editorial and business staffs of trade and technical periodicals, it will be open to all who are interested in the field. It is intended not only to give instruction, but to develop the business as a whole by setting up higher standards of editorial and business service and showing how these standards can be attained.

The following topics will be covered: Distinctive features of industrial publishing; its code of ethics; personal qualities required for success; determining editorial policies; getting the right kind of articles; securing accurate reports and data; writing for industrial papers; building up circulation; creating advertising; departmental management; service to the industry; service to advertisers; and basic policies and tendencies. "We look upon this undertaking," said H. M. Swetland, president of the United Publishers Corporation and chairman of the educational committee, "as one of the most important steps ever taken toward making industrial papers even more valuable to their readers and advertisers. Our own prosperity will grow in direct proportion to our growth in ability to render useful service." Those interested can obtain further information regarding the course and the classes by communicating with the secretary of the course in industrial publishing, 185 Madison Ave., New York City.

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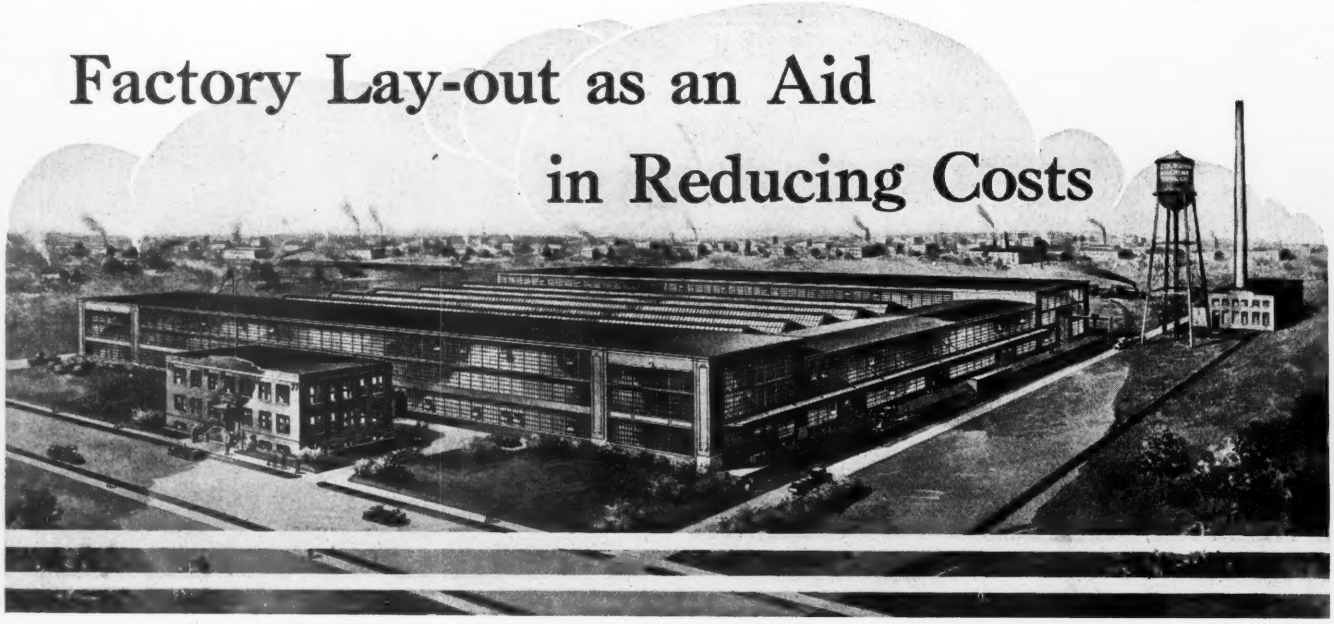
It is estimated that at the current rate of construction, the output of American shipyards for the present fiscal year will be about 2,250,000 gross tons, as compared with 3,735,000 gross tons, constructed during the year 1920.

Factory Lay-out as an Aid in Reducing Costs



A Description of the New Plant of the Colburn Machine Tool Co., Cleveland, Ohio, which has been Laid out with a View to Economy in Manufacturing

THE new plant of the Colburn Machine Tool Co., on Ivanhoe Road, Cleveland, Ohio, presents an example of how a well thought-out factory lay-out may aid in reducing production costs. A description of this plant will point to many desirable features in modern plant construction. A general view is shown in the heading illustration, the office building being located in front, but directly connected with the factory by a passageway.

The buildings are practically fireproof, being constructed of steel, brick, and cement, with steel window sashing and frames, and provided with a complete sprinkler system. The shop building, which is 310 by 280 feet, is designed with a front and rear flat-roof bay or head-house extending the full length of the building, these bays being connected on the north end of the structure by a third bay; the remainder of the space is covered with a saw-toothed roof, and is divided into five bays. The three high-roof bays are provided with traveling cranes, and serve as an assembling floor and receiving, shipping, and stock rooms, while the five bays in the center are devoted mainly to machining operations.

The office building contains, in addition to the executive offices, the engineering and advertising departments, which are located on the second floor. From the office a covered passageway leads into the shop, which is unusually well lighted and ventilated. The important factor of good lighting has been carefully considered in its effect upon production. All girders and steel framework are painted light gray, and the roof and window sash are white.

The front and rear bays, extending the full length of the building, are each 50 feet wide. From a point about midway of the front bay a main central traffic aisle extends to the rear, dividing the machine shop area and leading into the high bay at the rear. The main aisle and several side aisles, which lead into it, as shown in Fig. 2, are laid out by painting white boundary lines on the floor, which is paved with creosoted wood blocks set on a bed of solid concrete, 6 inches thick. The aisles are kept free and clear to facilitate transportation of materials, which is done either by means of a flat car, such as shown on the narrow-gage track extending through the shop to the yard at the rear, or by industrial motor trucks. The boundary lines are laid out and painted on the floor in the bays as well as in all aisles, the advantage of this traffic regulation being obvious.

There is a 15-ton Cleveland traveling crane, with a 5-ton auxiliary hoist, in the front head-house, with crane tracks extending the entire length of the bay. This crane travels on tracks placed high in the bay—about 8 feet higher than another crane of like capacity and design which is provided in the side bay that runs along the north side of the building. The tracks for this crane extend out into the front and rear head-houses, the object being to permit material to pass directly from one to the other by running the lower crane under the upper one. This arrangement, which is identical in both head-houses, is shown in the background of Fig. 1.

Fig. 1. View in Front Head-house used as Erecting Floor

The north bay is another clear passageway, 50 feet wide, extending the full depth of the building between the front and rear head-

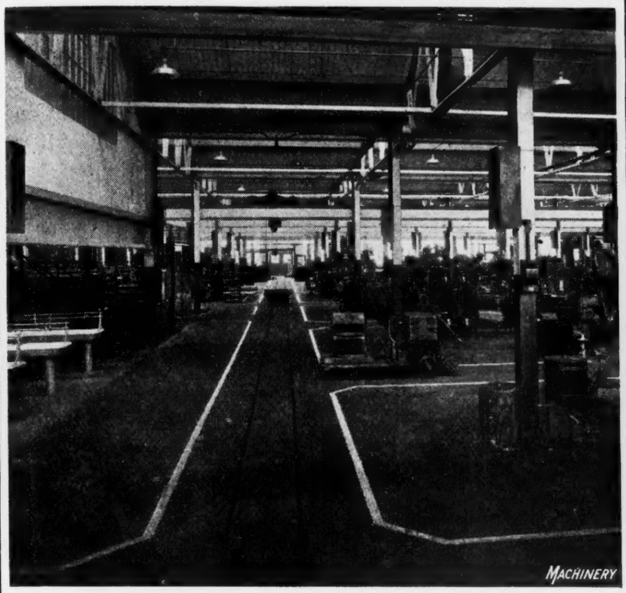


Fig. 2. Central Traffic Aisle, which runs entirely through the Shop, from Front to Rear Bay

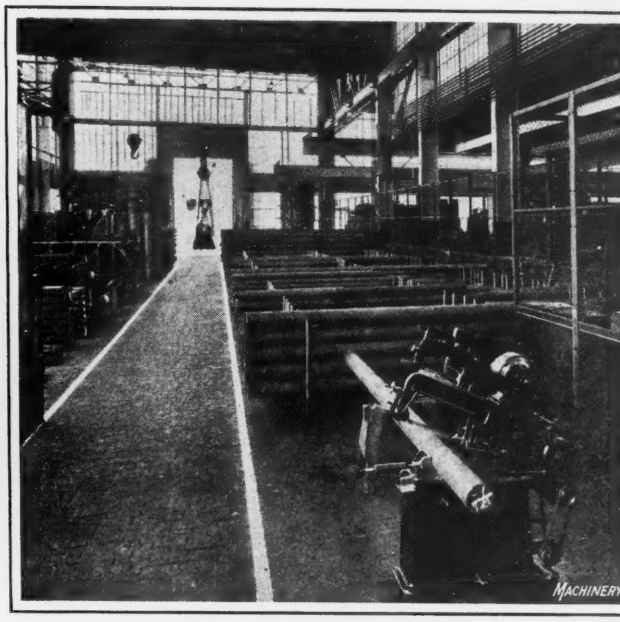


Fig. 3. Transportation Facilities provided from Receiving Platform to Storage Space

houses. Six double doors in the north wall lead to the receiving and shipping platform which also extends the full depth of the building. Running parallel with this platform is a concrete roadway for the accommodation of express trucks, etc., and between the platform and the roadway there is a spur track of the Nickel Plate Railroad. The convenience of this lay-out for handling material going to and coming from the cars will be apparent from an inspection of Fig. 5. The floor of the platform is made of concrete, and it is equipped with labor-saving facilities for loading and unloading freight cars. Two wire cable winches are installed under this platform so that heavy machines may be easily moved, or when locomotive power is not available, freight cars may be towed in from the main tracks, which are 1600 feet distant from the platform.

Cemented into the platform floor at both sides of the last door (which leads into the rear head-house) are two snatch-block hooks, provided so that tackle may be used to facilitate the unloading of material from the cars. From the platform it is picked up by a monorail traveling hoist, the overhead rail of which extends through the doorway out beyond the tracks of the railroad siding. This enables material to be delivered directly to the floor of the rear head-house. Fig. 3 is a view looking toward this doorway from the interior of this head-house, and shows, in addition to the hoist, the overhead crane installation, which is similar to that in the front head-house, previously described.

Arrangements for Storing Material

The rear head-house is used mainly as a storage room for property and stock, and is separated from the rest of the factory by sheet-metal and wire-mesh partitions. In this connection, it may be mentioned that all receptacles, desks, benches, racks, etc., as well as all partitions in the building are made of steel, and there are no wooden closets or shelves where inflammable material may accumulate and increase the fire hazard. All sheet-metal factory accessories used in the shop were furnished by the Hauserman Co., of Cleveland. Attention is directed to the appearance of the farther left-hand corner of this bay, in Fig. 3, where the larger castings are neatly arranged. The large bar stock is supported by sections of I-beam, laid in orderly fashion on the floor, and the smaller bar stock is stored on floor stands. This illustration also shows in the right foreground the metal-partitioned stock-room office, which is equipped with metal files for recording stock, and also the power cut-off saws.

The opposite, or south end of this bay contains metal bins which are used for storing jigs and fixtures and for such small parts as bolts, nuts, screws, gears, bushings, shafts, small castings, and similar parts; the electric power room in which the current converter and main switchboard are installed; the portable oil-tanks, industrial motor trucks, and certain millwright equipment such as rope and cables, tackle-blocks, ladders, etc. The storage room does not occupy the entire length of the rear head-house, but is partitioned off to provide space for the heat-treating department in the southwest corner of the factory. The end of the stock-room used for storing small parts is shown in Fig. 4.

Fig. 4. Stock-room, showing Bins used for storing Small Parts

Wash-room and Coat Room

The wash-room, which can be partially seen at the left in Fig. 2, is located near the left-hand corner of the main aisle and front head-house. Enamel-ware wash basins, hot and cold water, and complete sanitary equipment for the men are provided. An all-steel tool-crib is located at the rear of the wash-room and almost in the exact center of the shop, so it is convenient to all departments.

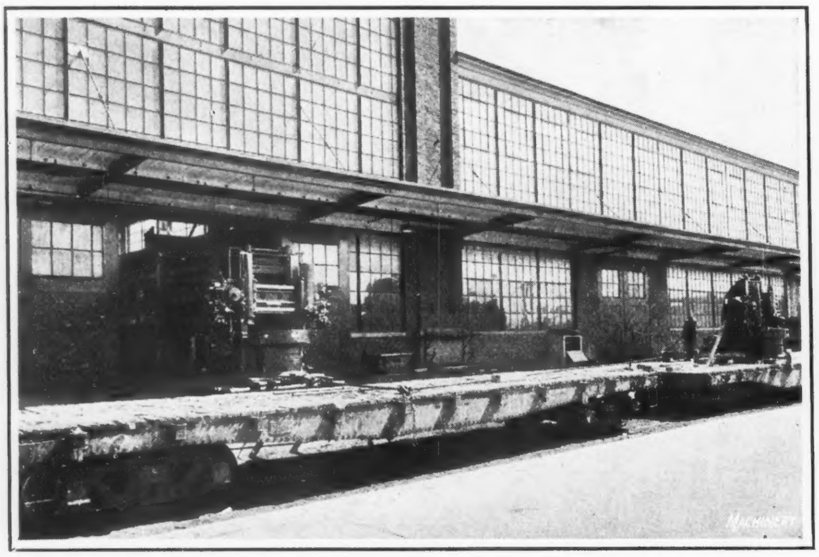


Fig. 5. North Side of the Factory, showing Facilities for loading Machines on Flat Cars

The workmen's entrance is on the south side of the building adjacent to the front head-house and leads into a well-arranged coat room constructed entirely of sheet-metal and wire-mesh. Metal hangers are suspended from an overhead framework, each of which is suitable for the accommodation of ten or a dozen men's clothing. Above the hooks for the clothing there is a shelf on which such things as lunches, towels, and other personal belongings may be placed, and they are protected from dust by a hood, or roof, which extends over the shelf. Ample space is left between these hangers for the men to pass without interfering with each other. Here again, the provisions for prevention of fire hazards and accumulation of dust and dirt are in evidence. During working hours a sliding door between the manufacturing floor and the coat room is kept closed.

There are no benches extending along or near the walls of the shop. Instead, individual portable metal benches are provided. There are many advantages to be derived from this departure from the usual shop arrangement, some of which are the elimination of a hiding place for debris and combustibles, better light, and more available working space.

Machine Installation and Arrangement

The machines in the manufacturing departments are arranged in rows with a spacious aisle between, each leading to the main aisle and its narrow-gage car track. All machine equipment is driven by individual motors which, in some cases, necessitated a rather complete change-over from the original drive of the machine. Fig. 6 shows a battery of Cleveland automatics on each side of the aisle, and also illustrates the mounting of individual motors and the method of connecting them with the machines. Operators are not permitted to tamper with the panel boxes from which the various motors receive their current. These boxes are attached to a post near each machine, out of the men's reach. The arrangement is well illustrated in both Figs. 6 and 7; the latter illustration shows one such box open, exposing to view the four switches which it contains. Each machine is provided with a start-and-stop push-button switch for switching the power on or off.

In reference to the installation of such equipment as automatic screw machines, attention is called to a provision for confining the dripping oil to the vicinity of the machine so that it will not be tracked into the aisles and all around the shop. The machines are each surrounded by a strip of angle-iron, forming a shallow drip-pan, 1 inch high, under the machine, which is filled with dry sawdust, the supply being replenished as occasion demands. This precaution keeps the passageway between the machines in a neat condition, and eliminates the danger of slipping on oily floors.

All machines are grouped in such a manner that the flow of work during the process of manufacture is always in the general direction of the front head-house, where the erecting of Colburn heavy-duty drilling machines and vertical boring and turning mills is done. Another group of machine tool equipment which shows the uniformity of arrangement is illustrated in Fig. 7, this being a line of multiple- and single-spindle drilling machines of this company's manufacture.

The heat-treating department, shown in Fig. 8, is situated in the southwest corner of the plant. Special care has been taken to provide for the removal of fumes, heat, and smoke by covering the furnaces with an overhead hood, which has flues that deliver impurities out of doors.

Electric Wiring System and Facilities

It has been mentioned that all machine tools have individual motor drive, and in this connection reference has been made to Figs. 6 and 7. The advantages gained by thus eliminating all overhead pulleys and belting are well known. The electric wiring is carried in wrought-iron pipe conduits with suitable switch panels and distribution stations located conveniently throughout the factory. By arranging all pipe lines, including sprinkler systems and feed pipes for the heating coils, so that they may be suspended near the roof, the entire space above the machines is left open.

The main electric current is furnished by a converter installed in the power room in the rear head-house. From the converter the current is delivered to six distribution panels located at various points throughout the shop. Two of the panels are for lighting purposes and four for furnishing power to the machines. These six panels are mounted high up in the sawtooth roof space, one panel being shown in Fig. 6 attached to the upper framework of the building. Between the distribution panel which serves any particular group and each machine in that group, there is a switch panel to which reference has previously been made. The

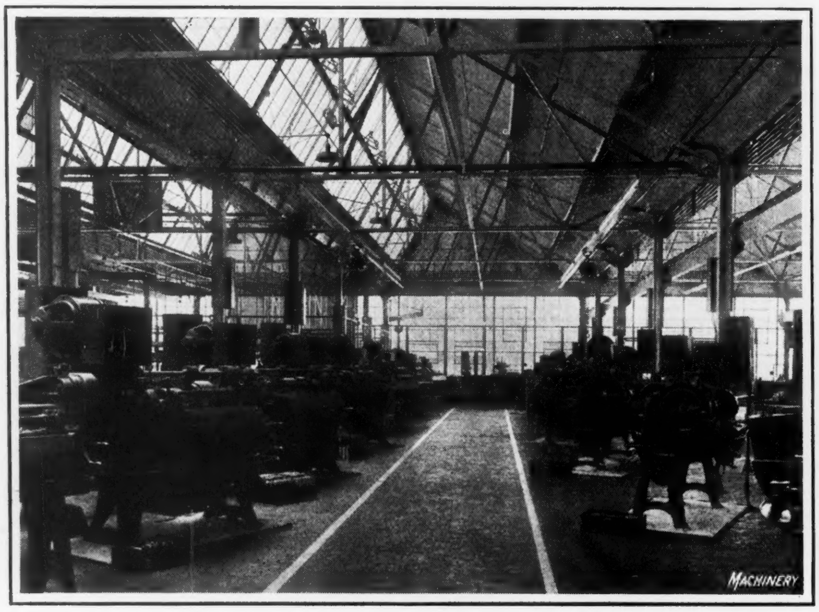


Fig. 6. Aisle in the Automatic Screw Machine Department, showing Individual Motor Drive

only person who has access to the switch panels is the regular shop electrician, who systematically examines the switches, blows out the dirt from the motors, and gives all the electric equipment general attention. It requires one week for him to make the complete rounds, giving each motor and switch the necessary attention, so that all equipment is visited at least once in that period of time.

One interesting feature of especial note in connection with the electrical equipment is the provision of testing machines on the erecting floor. The entire row of columns between the front head-house where the erecting is performed and the adjacent parallel bay in which the assembling department is situated is equipped with special switch boxes. The switch boxes are arranged so that not only the motor for driving the machine may be plugged in, but small electric tools may also be connected up by the use of sockets, as, for example, portable drills, which are often required in the final finishing of a machine before shipment. This enables a drilling machine or boring mill to be tested wherever it is located, without moving it. Much time is thus saved, and the result is a considerable and direct reduction in the cost of performing this necessary work. This factor in the lessening of production costs should always be taken into account by the manufacturer, especially if the product is heavy, as is usually the case with machine tools.

A complete auto call and intercommunicating telephone system is provided, and also a Stromberg time recorder. Horns located in various parts of the shop which announce starting and stopping time operate automatically and are synchronized with the time system.

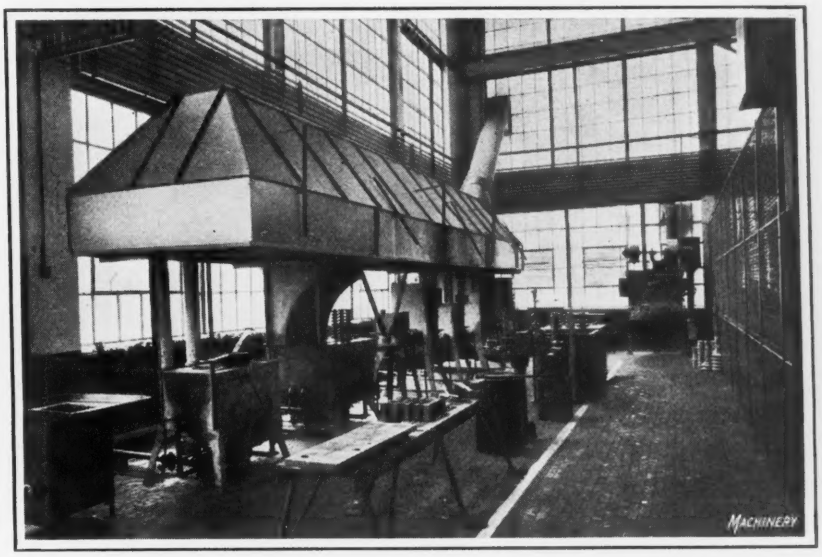


Fig. 8. Heat-treating Department—Note Provision of Overhead Hood for carrying off Fumes and Smoke

Relation of Systematic Lay-out to Production

The incoming raw material when it arrives on the receiving platform can readily be transported by means of the crane system and other equipment, either to the storage space and thence to the machine shop, or direct to the manufacturing department. The lay-out of the cranes and traffic aisles is the result of careful planning, and the arrangement finally evolved is such as to offer the least resistance to the steady flow of the product being machined. If the material is in the form of bar stock, it is cut to length on a power saw in the stock-room and then routed to the first-operation machine. The lay-out is such that the material always moves in the same general direction, arriving in the front head-house for erecting without unnecessary handling.

Upon arrival of the finished product in the erecting department, it is subjected to the usual fitting, scraping, and testing, and is then picked up by the crane in the front head-house and delivered to the auxiliary side-bay crane, and thence to the shipping room which occupies a section of the side bay adjacent to the shipping and receiving platform. Here there is installed suitable woodworking machinery for crating machines.

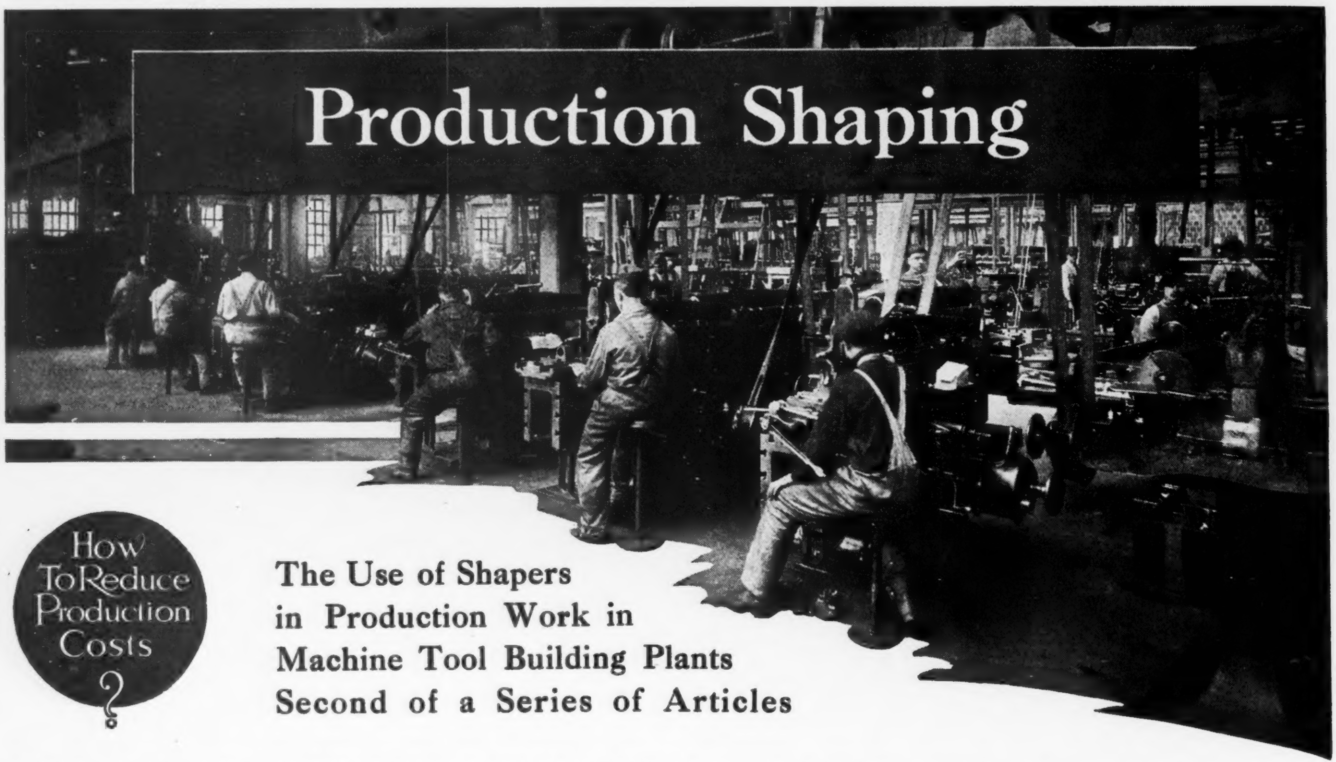
* * *

WELDING BROKEN ARMATURE SHAFTS

Large armature shafts occasionally break at the junction of the journal and the pulley end. While recognizing the adaptability of the thermit welding process to the welding of large steel shafts, operators sometimes, in this case, decide to scrap the old shaft, fearing that the heat of the steel produced by the thermit reaction might injure the armature coils and produce short circuits. However, it has been the experience of the Metal & Thermit Corporation, of New York City, that when the armature coils can be separated from the fracture by a few inches of molding sand (at least about 4 inches in the case of a 3-inch diameter shaft) a repair by this method is entirely feasible without injuring them, if the following simple precautions are observed. There is no danger of damaging the armature windings through the effect of direct heat, as the fracture is completely surrounded by molding sand and all preheating is confined within this molding sand. The heat which is conducted along the shaft is readily taken care of either by directing an air blast on the shaft or, where necessary, by using a specially constructed water-cooler box with a packing box on the shaft to prevent the possibility of any water coming in contact with the windings. The windings themselves are further protected by being totally encased in an oil-cloth and burlap bag.

In case the keyway of the pulley end of an armature shaft becomes badly worn, this end can be removed and a new over-size extension welded on and machined down. A large number of such extensions have been thermit-welded satisfactorily. As an example of costs, an extension to a 3½-inch shaft can be thermit-welded for about $35.

Fig. 7. View in Another Machining Department, showing Excellent Lighting



Production Shaping

How To Reduce Production Costs?

The Use of Shapers in Production Work in Machine Tool Building Plants Second of a Series of Articles

IN the first installment of this series of articles dealing with the use of shapers on production work, attention was called to the various advantageous features of machines of this type. In shops engaged in the building of shapers, it will be obvious that it is desirable for the manufacturer to have such machines in operation in his plant, which are then available for exhibition purposes. This can be done to peculiar advantage because in the manufacture of shapers there are many parts of small or medium size, for the planing of which the shaper is especially well adapted. Typical examples of such work are illustrated and described in this article; in addition to showing the range and flexibility of the shaper, the methods are of general application, so that they could be applied with equal success on many other lines of work, for reducing costs and increasing production.

Planing Steptoe Shaper Column Castings on the Shaper

On shapers built by the John Steptoe Co., the ends of the column castings are planed, and this work was formerly done on a shaper. Little thought will be required to make it apparent that work of this kind is too large to be advantageously handled on this type of machine; but the present example clearly shows the capacity of a shaper in an emergency. Fig. 1 shows this job set up on an old-style triple-geared Steptoe shaper.

A fixture *A* is hung on the shaper cross-rail in place of the apron, which provides for feeding the work transversely or for adjusting its vertical position; the fixture is also provided with a graduated swivel, so that the work may be adjusted for planing different surfaces. This is the means of effecting a substantial saving of time in setting up these castings, because after the end of the shaper column has been planed, as shown in the illustration, it may be swiveled through 90 degrees for planing the ends of the bearing bosses that carry the transverse shafts. Then the work can again be swiveled through 90 degrees to bring the opposite end of the casting under the tool for planing the bearings for the cross-rail, after which a third swiveling of the work brings the opposite side into position for planing.

Thus it will be apparent that all four sides of the work can be planed at a single setting, and even though the shaper may be a little slower than the planer, the possibility of completing all the machine work at a single setting would offset the difference in speed, so far as the total production is concerned. Notches are cut in the flange of the rotary fixture, one notch being shown at *B*, so that the column can be properly located in successive positions for performing the planing operations.

Planing Shaper Table Support

At the plant of the John Steptoe Co. a shaper of this firm's manufacture is employed for planing the table support for Steptoe shapers. These would be rather difficult pieces to hold on any other type of machine, and it has been this company's experience that the work can be done to the best advantage on a shaper. In Fig. 2, which illustrates a Steptoe shaper equipped for this operation, it will be seen that the shaper table has been removed, and that holes have been drilled and tapped in the apron to receive two bolts *A* which hold each casting in place while the operation is in progress.

A method of this kind constitutes a simple means of attaching the work to the machine, but obviously there would be too much overhang if some adequate form of outboard support were not provided. For this purpose, two jacks *B* are utilized, one end of which is entered into T-slots in the apron, the opposite ends engaging a flange in the outer extreme of the work. The planing operation is not unusual, use being made of a round-nosed tool for taking a roughing cut on the area surrounding the slot *C* in the table support, and a square-

It might be expected that builders of shapers would have machines of this type operating in their plants under the most advantageous conditions, and the visitor who has an opportunity to see the work done in some of these plants will find this to be true. Shaper builders have developed the use of their machines to a high standard of efficiency, and the results they obtain in everyday practice give ample evidence of the possibilities of the shaper in regular production work. In selecting material for this series of articles, the operations have been chosen with a view to showing what the shaper is capable of accomplishing when employed on manufacturing jobs.

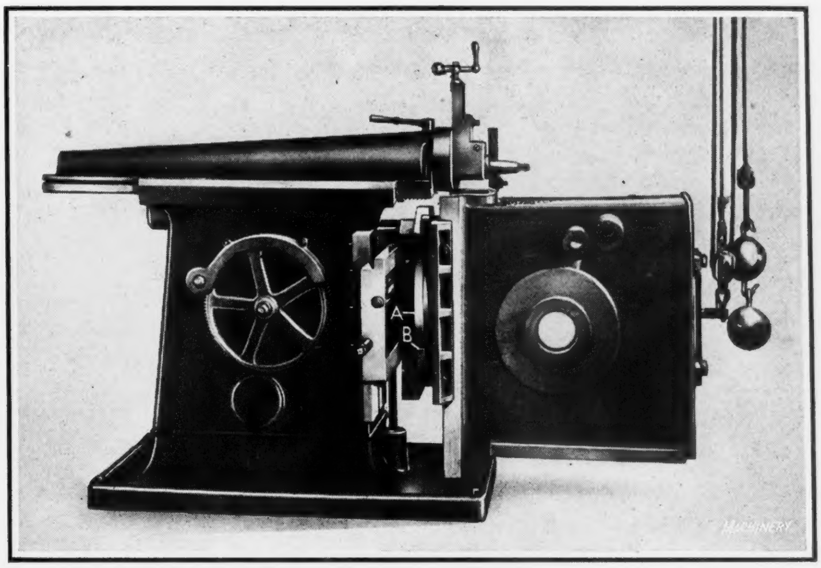


Fig. 1. Fixture used in holding Column Casting of a Shaper for planing Four Sides of the Work at a Single Setting

nosed tool for performing the finishing operation.

Planing a Hendey Shaper Ram

In the illustration Fig. 4 is shown a 20-inch crank shaper built by the Hendey Machine Co., which is equipped for performing a planing operation on the top of the ram for a shaper of this company's manufacture. The point of special interest in this connection is the application of an extension table *A* for handling long pieces of work. This table extension is a substantial casting of triangular outline. The top or working surface is of uniform thickness and has T-slots corresponding with the top surface of the regular table. The side supporting walls of the extensions are under-cut, to save metal. The dividing line between the main table and the extension is shown by the termination of the T-slots on the side. The extension is fastened to the front end of the table by means of five bolts and two tapered dowel-pins, so it can be readily taken off when desired, and replaced in perfect alignment.

The shaper ram *B* has had the dovetailed bearing planed on its under side before being set up on the shaper for performing the operation here illustrated. The casting is set on two parallel blocks *C*, and held down by bolts entering the table T-slots and straps *D* extending over the top of the work. The planing operation consists merely of taking roughing and finishing cuts over the flat surface surrounding the slot at the top of the ram.

Planing Rocker Arms for Springfield Shapers

On the so-called "stroke" or rocker arm for the single-geared shapers built by the Springfield Machine Tool Co., there is a cylindrical member *A*, Fig. 3, at the top, which is machined to the required form on a Springfield shaper equipped as shown. The machine is furnished with a special rotary fixture that provides for revolving the work as the tool reciprocates back and forth across it, thus generating a cylindrical shaped pivot *A* of the required form. This is the method employed for machining rocker arms for 12- and 15-inch single-geared Springfield crank shapers.

The fixture is so arranged that it is only necessary to set the casting in position and locate the cylindrical pivot that is to be planed from a round disk on the fixture. This disk is directly behind the work, and serves the double purpose of locating the casting, and of providing a reference point from which the tool is set in order to plane the work to the required size. It will be noticed that the circular feed is taken from an auxiliary ratchet *B* connected to the feed mechanism of the shaper, and transmitted through a worm on shaft *C* that meshes with worm-wheel *D* on the fixture. The operation is performed at a single cut, with a very fine feed, and it requires about forty minutes to set up the casting and finish it to the required form.

Shaping Operations on a Queen City Shaper Rocker Arm

In machining rocker-arms that transmit motion from the crank to the ram on shapers built by the Queen City Machine Tool Co., it is required to face off the bearing bosses on the inside of a yoke at one end of these castings. The operation, as performed on a 24-inch shaper of this company's manufacture, is shown in Fig. 5. The side of the rocker arm that rests against the table, and the wide slot for the crankpin sliding block, are machined previously. The work is drawn squarely against the side of the table by the two bolts *A*, and the thrust of the cut is taken by

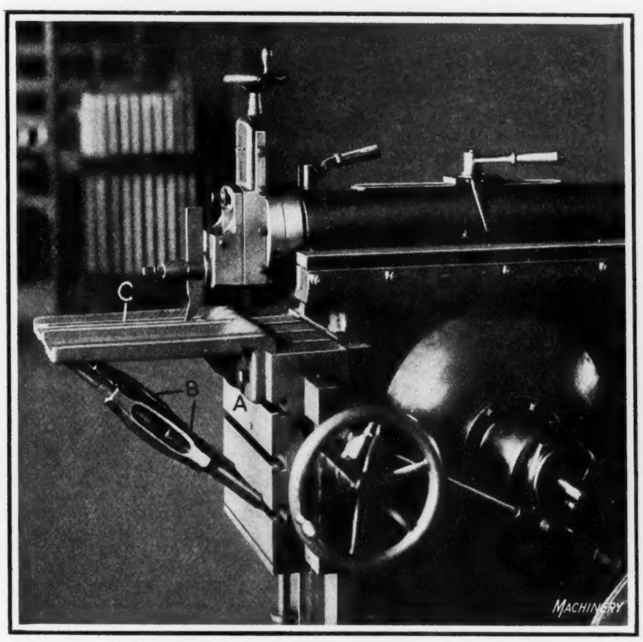


Fig. 2. Method of setting up Shaper Table Support for performing a Short Planing Operation on the Shaper

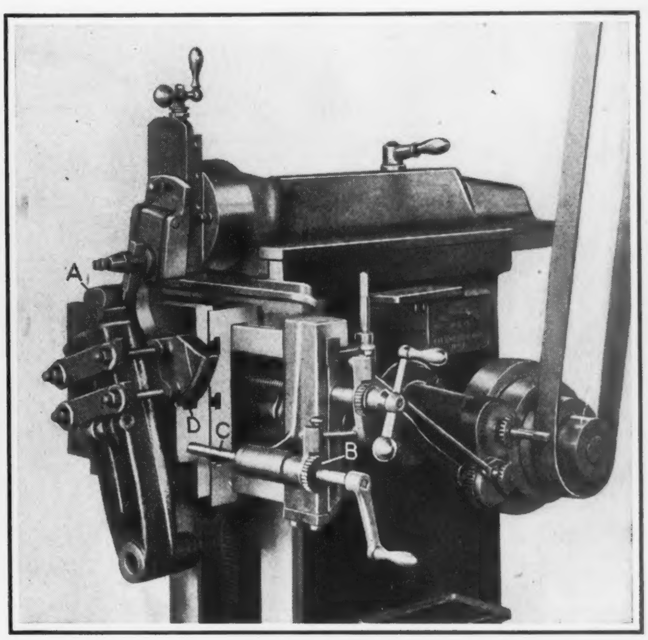


Fig. 3. Use of Rotary Fixture for holding Shaper Rocker Arm to guide Work for shaping Bearing A

a long block fitted to the slot in the rocker arm and bolted and tongued to a vertical T-slot on the side of the table.

After the work has once been set up, the table remains in this position, the operation of facing down the two opposite bosses being performed with a tool-holder carrying two cutter bits that machine the faces of the bosses simultaneously. A roughing and a finishing tool are employed, and a tool-setting gage is used to insure the correct relation between the tool and the finished face on the side of the arm. The simplicity of the holding devices, as well as the adaptability of the shaper for this job, enables an average production time per piece of only six minutes to be attained.

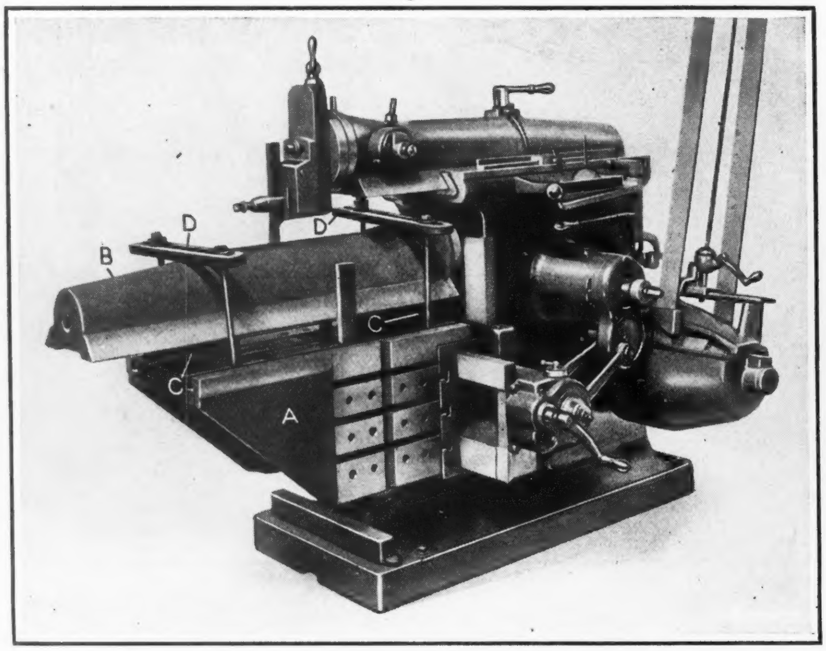


Fig. 4. Use of a Table Extension to afford Outboard Support for a Shaper Ram while performing a Short Planing Operation

Planing the Slot in a Smith & Mills Shaper Rocker Arm

For machining the rocker arms used in shapers built by the Smith & Mills Co., use is made of one of this company's 28-inch back-geared, single-pulley drive machines for finishing the slot in the arm that receives the sliding crank block. Fig. 6 illustrates this operation, and it will be seen that a tool-holder with two cutter bits is used for simultaneously machining the two sides of this slot in order that they may be finished parallel with each other and with exactly the required spacing between the sides. This is a regular production job, and the special work-holding fixture shown in the illustration is used for holding the work.

Mention has previously been made of the three-point principle for obtaining a preliminary support for rough castings, in order to compensate for slight inequalities in their size, and to insure obtaining a firm foundation for the work. This fixture has three screws by means of which the casting is leveled up, the correct setting being determined with a surface gage; and after this part of the setting has been accomplished, the work is lined up in the fixture by the adjustment of four screws A, which also tend to hold the work against sidewise movement. Tests for accuracy of alignment are made from the edge of the table to the work with a surface gage. Final clamping is accomplished by means of straps B that hold the work down on the fixture. After the casting has been leveled up and brought into alignment with the line of travel of the shaper tool, the tool is centered over the work by the regular adjustment of the saddle on the shaper cross-rail.

Both the roughing and the finishing tools are of the double-point type shown in Fig. 6, but the finishing tool is required to bring the width of the slot to exactly the desired dimension, and in order to compensate for wear that occurs in sharpening, there is a wedge C that is forced down between the two cutter bits D by means of an adjusting screw E, so that the tools may be adjusted to plane the slot to exactly the required width. For both the roughing and finishing operations, the feed is 0.032 inch, and the

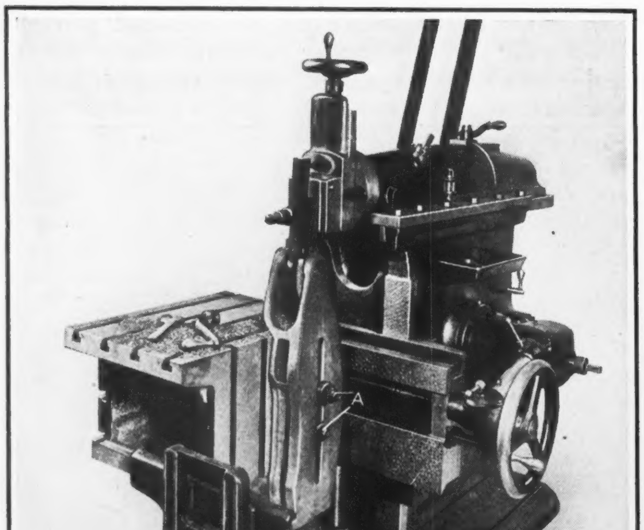


Fig. 5. Application of a Duplex Tool for simultaneously planing Inside Faces of Yoke Bosses on a Shaper Arm

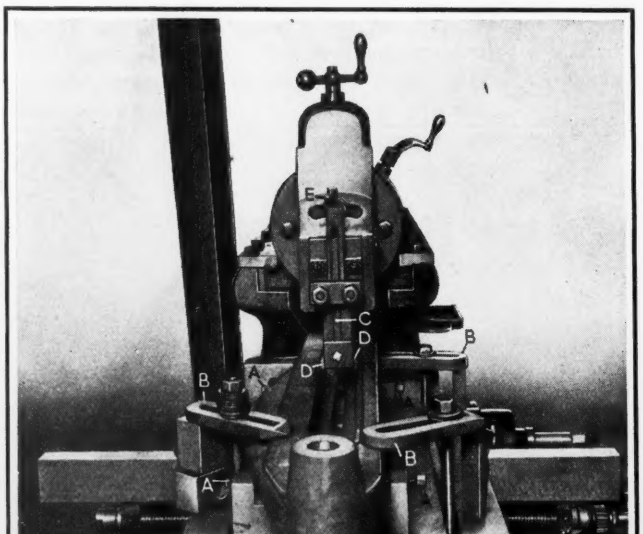


Fig. 6. Crank Shaper equipped for simultaneously planing Sides of Slot in Rocker Arm for a Shaper

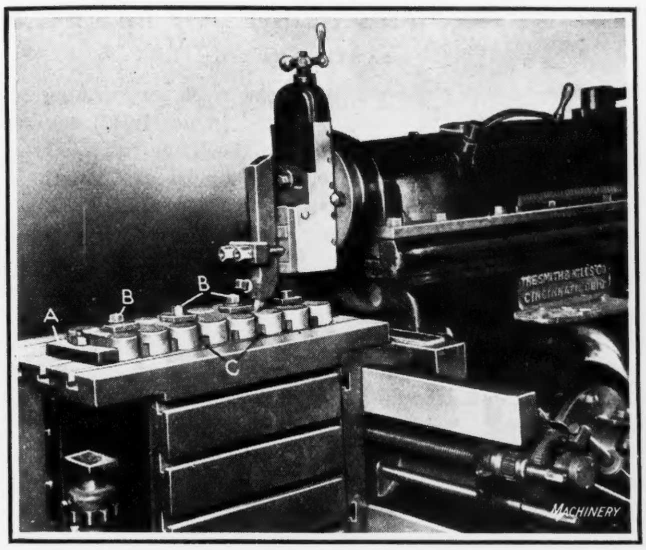


Fig. 7. Crank Shaper equipped for planing the Bosses on a String of Eight Shaper Pendulum Links

cutting speed 35 feet per minute. The time required for this operation is one hour and a half, which includes the time necessary for planing the horizontal top face of the rim which surrounds the slot.

Performance of String Planing Operation on a Shaper

In many plants where there are limited numbers of small and medium sized parts on which it is required to plane the faces of bosses and to perform similar operations, it will be found that a shaper is well adapted to the requirements of such work. Fig. 7 illustrates a Smith & Mills 28-inch back-geared shaper with single-pulley drive, which is used

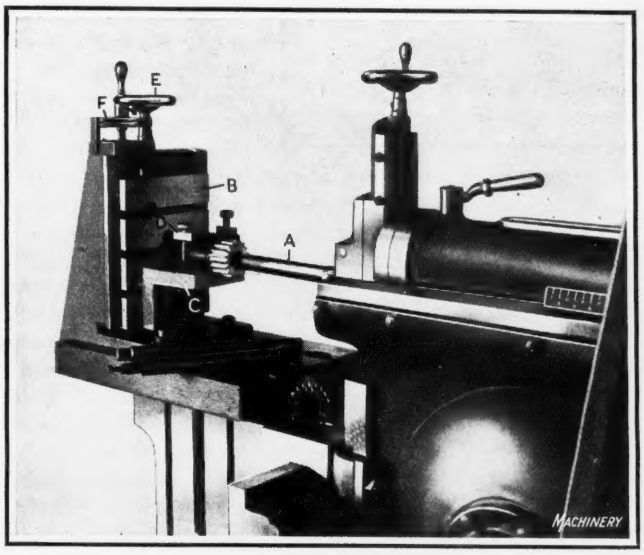


Fig. 8. Use of a Keyseating Fixture for machining the Keyway in Bronze Sleeve Gears for Shapers

in this company's shop for planing both sides of bosses at opposite ends of short links of the form shown clamped to the table of the machine. It will be seen that eight of these pieces are set up at a time, and there are four faces to be finished on each link.

The operation is quite simple, consisting of taking a roughing cut with a round-nosed tool and a finishing cut with a square-nosed tool. The method of setting up the work is also simple, and is well shown in the illustration. A bar A is utilized as an end-stop, and this serves the double purpose of squaring up the work with the line of travel of the ram, and of supporting the end thrust of the tool. It will be seen that straps and bolts B are placed between each pair of castings to hold them down on the table, and small blocks C are put between the ends of each pair of links, because these pieces of work are larger at the center than at the ends, and if some precaution of this kind were not taken there would be a tendency for the thrust of the tool to swing them about their central points. For taking a roughing and a finishing cut on both sides of both ends of eight of these links, that is to say, planing thirty-two faces, the production time is about one hour and twenty-five minutes.

Application of the Shaper for Keyseating Bronze Sleeve Gears for Steptoe Shapers

Another application of a shaper in the John Steptoe Co.'s plant is shown in Fig. 8. This is a keyseating operation in the bronze sleeve gear for machines of this company's man-

Fig. 9. Using an Indexing Shaper Fixture for planing Gear-boxes

ufacture. In this illustration one of the gears is shown lying on the table, and a second gear will be seen in place in a keyseating attachment that is supplied as an auxiliary equipment for use in shops that have an occasional keyseating operation to perform. It does not find wide application, but in repair shops where there would not be sufficient

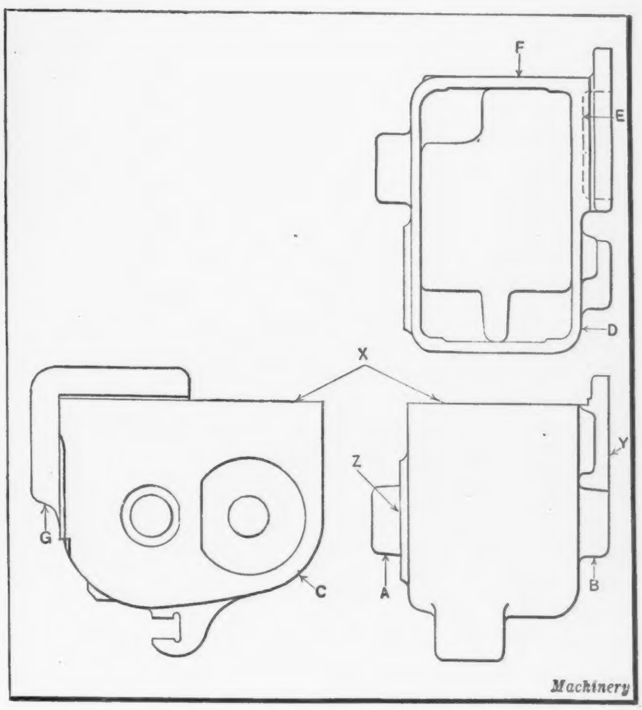


Fig. 10. Outline of Gear-box planed in Fixture shown in Fig. 9

work to justify purchasing a keyseater, this fixture is often found useful.

The tool-holder *A*, mounted in the shaper ram, is made of sufficient length so that it can be reciprocated back and forth through the axial hole in the gear and its shank. The attachment is provided with a vertical table *B* having T-slots planed in it for attaching various work-holding fixtures. In the present instance the fixture consists of a block *C*, bolted to the table and provided with two clamping bolts and a strap *D* for holding the work down. The position of the vertical table *B* is adjusted by a screw having a handwheel *E* on the end. A stop-screw that is positioned by a graduated dial *F* enables the depth of the keyseat to be accurately controlled.

Indexing Shaper Fixture for Planing Gear-boxes

In the plant of Gould & Eberhardt, shapers of this concern's manufacture are used for short planing operations on gear-boxes. One of these machines is shown in operation in Fig. 9, where it will be seen that the gear-box casting *A* is set up in a box-type work-holding fixture pivoted at *B*. An index-pin provides for locating the fixture in successive positions, so that planing operations may be performed on three sides of the work without requiring the casting to be reset. This is the means of effecting a substantial saving of time in the performance of planing operations.

Fig. 10 shows an outline drawing of the gear-box casting. It rests on the trunnion fixture on fixed supports which make contact with the casting at points *A*, *B*, *C*, *D*, *E*, and *F*. Point *G* rests on a support which is adjustable to compensate for variations in the casting. The latter is clamped in place in the fixture by set-screws located directly opposite the supporting points to eliminate distortion. The first operation on the part consists of roughing and finishing the top surface *X*; the second operation consists of roughing and finishing the back surface *Y*; and the third and final operation consists of roughing and finishing front surface *Z*. Means are provided on the fixture for accurately and quickly setting the tool so that the three finished surfaces are machined in the correct relation to the rough casting.

* * *

CREDIT SERVICE FOR SHOP EQUIPMENT

The Black & Decker Mfg. Co., Baltimore, Md., manufacturer of portable electric drills, grinders, and electric air compressors, has recently put into effect a unique credit service. The company sells its products entirely through jobbers, and the new credit service enables users of Black & Decker equipment to buy through their regular jobber by paying 23 per cent of the price in cash and the balance in six equal monthly payments. Nothing is added to the standard price for the long-term credit, and no interest is charged. A conditional sales agreement is made, whereby the product sold becomes the security for the sum to be paid until entirely paid for. The Black & Decker Mfg. Co. shares the responsibility equally with the jobber for the fulfillment of the sales agreement. The purpose of this service is to enable the user to put cost-reducing equipment into his shop without a heavy investment, and to make it possible for the equipment to practically earn its own cost while it is being paid for. It is generally acknowledged that the principal obstacle in the path of normal sales today is a financial one, and the purpose of this plan is to overcome this difficulty as far as possible.

ESTIMATING THE WEIGHT OF BAR STEEL

By HYMAN LEVINE

Tables giving the weights of bar steel per running inch and per running foot may be found in nearly all engineering handbooks; and by the use of these one can easily calculate the weight of steel bars of almost any length and section. It frequently happens, however, that inspectors, salesmen, draftsmen, designers, and shop executives require a rough estimate of the weight of bar steel when a handbook is not available.

The formulas given in the accompanying table will be found particularly useful in such instances, as they provide a means of calculating the approximate weights of various sections and lengths of steel. The formulas are so simple that they may be readily memorized, and the results obtained are sufficiently accurate to warrant their use for many practical purposes. It is possible, of course, to rearrange these formulas so as to avoid the necessity of making any additions or subtractions; thus for round steel the weight per inch of running length would equal $\frac{2\frac{1}{4}D^2}{10}$, approximately, and for square steel $\frac{2\frac{7}{8}D^2}{10}$, approximately. Experience has shown that it is easier mentally to multiply by 2 and then increase this result by 10 per cent or 1/10 than to multiply by 2¼. It is likewise less difficult to multiply by 3 and subtract 5 per cent or 1/20 than to multiply by 2⅞. In some instances sufficiently accurate results may be obtained by disregarding the amount to be added or subtracted.

FORMULAS FOR ESTIMATING WEIGHT OF BAR STEEL

Section	Pounds per Inch of Running Length	Error	Pounds per Foot of Running Length	Error
Round (D = diameter)	$\frac{2D^2}{10} + \frac{1}{10}\left(\frac{2D^2}{10}\right)$	1 per cent low	$2.5D^2 + \frac{1}{10}(2.5D^2)$	3 per cent high
Hexagon (D = width across flats)	$\frac{2.5D^2}{10}$	2 per cent high	$3D^2$	2 per cent high
Square (D = side of square)	$\frac{3D^2}{10} - \frac{1}{20}\left(\frac{3D^2}{10}\right)$	1 per cent high	$3.5D^2 - \frac{1}{20}(3.5D^2)$	1 per cent low

Machinery

In using the formulas, dimension *D* must be given in inches. Thus a bar of 3-inch round steel, 10 inches long, would be estimated to weigh

$$\left[\frac{2 \times 3^2}{10} + \frac{1}{10}\left(\frac{2 \times 3^2}{10}\right)\right] \times 10 = 19.8 \text{ pounds}$$

or approximately 20 pounds. The actual weight of this bar is 20.03 pounds. A bar of 1-inch hexagon steel, 5 feet long, will be estimated to weigh $(3 \times 1^2) \times 5 = 15$ pounds; while the actual weight is 14.65 pounds. A bar of ½-inch square steel, 8 inches long, would be estimated to weigh

$$\left[\frac{3 \times (\frac{1}{2})^2}{10} - \frac{1}{20}\left(\frac{3 \times (\frac{1}{2})^2}{10}\right)\right] \times 8 = 0.570 \text{ pound}$$

The actual weight is 0.566 pound. Where the size of the steel cannot be easily calculated mentally, a handbook may be used.

* * *

The Pittsburg chapter of the American Society for Steel Treating plans a number of activities for the coming season. Many prominent speakers have been secured for coming meetings, which will be held on the first Tuesday of each month. At the meeting held in September, Prof. MacIntosh of the Carnegie Institute of Technology, Pittsburg, spoke on the metallurgy of iron and steel. The October meeting was addressed by Mr. Carpenter, president of the E. F. Houghton Co., Philadelphia, Pa., his subject being "Individualism versus Socialism." This month, Professor Sauveur of Harvard will speak on the heat-treatment of steel, and in December Professor H. F. Moore of the University of Illinois will discuss fatigue testing and resistance of materials. In January, the subject will be alloy steels. For further information address E. C. Cooke, 108 Smithfield St., Pittsburg, Pa.

Machine Tool Markets in Asia*

By W. H. RASTALL, Chief of Industrial Machinery Division, U. S. Department of Commerce, Washington, D. C.

THE largest proportion of the foreign market for machine tools has always been in Europe. In 1910, 81 per cent of the foreign shipments went to Europe; in 1913, 76 per cent; in 1915, 89 per cent; in 1918, 74 per cent; in 1919, 69 per cent; and in 1920, 57 per cent. Because of this large market in Europe there has been a temptation to overlook other machine tool markets of the world. Asia has never been considered a very good market—at least it was not so considered previous to the war, but there have been great changes since. Asia is developing in a way that few understand unless they have given this subject close attention.

Past Machine Tool Exports to Asia

In 1910, all the countries of Asia bought only $156,000 worth of American metal-working machinery. In 1913, this export grew to $200,000, and in 1915 to $500,000. A tremendous change in this market took place about 1918. In that year, metal-working machinery to a value of $5,900,000 was exported to the Asiatic countries, the exports in 1919 being $8,800,000, and in 1920, $7,400,000.

In spite of the tremendous expansion industrially that has taken place in Europe, the ratio of industrial expansion in Asia has been even more rapid in the last few years, and has been practically sustained during recent months. The indications are that the exports of metal-working machinery to Asia for 1921 will be valued at about $6,000,000. In other words, the 1921 market in Asia will probably show an even better result than in 1918.

Comparison of Asiatic and Other Foreign Markets

If we compare the Asiatic market with that of other non-European markets, we find that whereas Asia took $7,400,000 worth of metal-working machinery in 1920, Australia absorbed not much more than $1,000,000, and South and Central America, $4,000,000. The significance of this tremendous development in the absorption of metal-working machinery by Asia should be duly recognized. Asia has absorbed more metal-working machinery from America in the last three years than she would have absorbed in an entire century at the rate at which metal-working machinery was imported previous to the war.

Whatever has wrought the change, the fact remains that during the war there was a great industrial agitation in Asia, which has continued since. The Japanese market is comparatively well known, because Japan has absorbed important quantities of machinery for several years. However, it has been felt that Japan was a little different from the rest of the Asiatic continent. Speaking in round numbers, Japan has absorbed 50 per cent of the machinery shipped from the United States to Asia during recent years. China, on the other hand, in spite of her large area, tremendous population, and resources, has absorbed but 15 per cent.

Both the Chinese and Japanese markets are comparatively well known to the American manufacturer, but the markets of British India and the markets of the Dutch East Indies are not so well known. It is therefore of importance that American machine tool builders recognize the great change that has taken place and the relative importance of the markets of all the Asiatic countries. Of all the metal-working machinery shipped abroad from the United States, Asia absorbed in 1913 only 1 per cent, and in 1915 only 2 per cent. But in 1918 Asia took 11 per cent; in 1919, 15 per cent; in 1920, 17 per cent; and the indications are that in 1921 Asia will absorb 25 per cent of the machine tool exports. These figures should be carefully considered.

When the conditions as they exist in Asia today are contrasted with those in the Latin American countries and in Europe, the most startling differences will be found. Latin America, comparatively speaking, is unpopulated; Asia is densely populated. The resources of Latin America possibly are unexplored, but at any rate, so far as they are known and accessible, they are comparatively limited. The natural wealth of Asia is enormous, the mineral wealth alone being equal to or greater than that of any other continent. Asia is now developing rapidly in an industrial way, and probably the most rapid development is taking place in British India.

British India as a Machine Tool Market

Before the war it appears that it was British policy to keep India as a producer of raw materials and to take these to Europe, manufacturing them into finished materials in the United Kingdom. This policy has been changed, and now the government of India, native and British financial interests, and everybody concerned with controlling the destinies of the Indian Empire appear to have decided upon the policy that India shall be industrialized. That statement should be brought home to American manufacturers with all the emphasis that it is possible to put into it, because a definite step is being made to establish, in a methodical way, industries throughout the Indian Empire. The natural resources of the country are being studied. It has been stated that it is possible to produce pig iron in India and lay it down in San Francisco at the competitive price. One large steel plant has been developed, mostly under the guidance of American engineers, and there are now several other large enterprises in the metal-working field being planned—foundries, railway car shops, rolling mills for both rails and structural steel, and machine-building shops.

It is impossible to say how much and how rapidly this development will grow, but it may be stated with certainty that India is being industrialized as rapidly and as effectively as British and Indian interests can accomplish it. The figures of exports of American metal-working machinery to India will illustrate this point. In 1910 the exports were valued at $45,000; in 1913, at $43,000; and in 1915, at $23,000. A great change took place between 1915 and 1918, when we find the exports amounting to $1,250,000. In 1919 they amounted to $900,000, and in 1920 to $1,375,000, this last figure representing nearly 20 per cent of the entire metal-working machinery export to Asia.

Selling Machinery in Asia

One of the first questions that will be asked is, "How should one sell machinery in Asia?" Fortunately, it is easy to give a definite answer. One hundred per cent of the machinery sold in Asia is sold through the import merchant there. This import merchant corresponds more or less to the export merchant as he is known in the United States. The only practical way to sell machinery is through these merchants. The Department of Commerce at Washington is now doing everything it can to assist machine builders in developing their foreign business. The department has reasonably complete lists of machinery dealers in every important city in the world, and this information can be obtained either by correspondence or by a personal call at the Bureau of Domestic and Foreign Commerce.

*Abstract of address made before the National Machine Tool Builders' Association's convention in New York City, October 20.

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REDUCING PRODUCTION COSTS

The articles in October MACHINERY describing some of the modern machines, tools, and other interesting devices and methods for reducing manufacturing costs, have received a great deal of attention, and MACHINERY acknowledges the receipt of many favorable comments, but especially appreciates the active cooperation of the manufacturers in this serious effort to spread useful information on the greatest need of our time in industry.

Material along the same definite lines will be found in the present number of MACHINERY, and in December and January there will be substantial additions to it. In this number, specific examples of cost reduction will be found in the articles on "How Factory Investigations Reduce Costs"; "Production Work in the Locomotive Shop"; "Machining Hudson Super-six Pistons"; "Drawing Dies for Manufacturing a Carburetor Bowl"; "Production Shaping"; and others. All of these articles give practical suggestions indicating how machine tools and accessories may be used to best advantage in different lines of manufacture.

It is no longer wise to say that prices *will be* reduced, that competition *will be* keen; prices *have been* reduced, competition *is* keen, and the way to meet this changed situation successfully is to adopt machines and methods which produce with the lowest relative operating outlay.

A great many manufacturers have wisely used the time this period of slackness has forced upon them to investigate new machines and improvements for getting results and cutting costs. Those who utilize the dull present to make a thorough study of the machines, shop methods and varied equipment and materials now available in a buyer's market for giving better results at lower costs are laying up solid foundations upon which to build the business they must work harder to get and hold than ever before.

* * *

A DEVELOPMENT IN GRINDING

The extensive use of the automobile has developed a new kind of repair shop, of which hundreds have been started all over the country, for the purpose of regrinding automobile cylinders. These shops are usually independent enterprises, soliciting their work both from the garages in the vicinity and from individual automobile and truck owners. Grinding machines have been developed especially to meet the mechanical needs of these shops, and the demand for them has created an additional outlet for the product of some grinding machine manufacturers which has helped to keep their shops running during the present depression.

Many machinists who were out of employment have started small shops of their own in the regrinding business, often taking on a general line of repair work in addition. In some instances these shops undoubtedly will expand into larger enterprises.

The regrinding of automobile engine cylinders, when carefully and accurately done, may add years to the life of a car and make it possible to maintain or even improve the running qualities of the engine. It is likely that within the next few years many developments will be made in appliances for repairing and maintaining automobiles, and some machine tool manufacturers will doubtless specialize in providing equipment for shops engaged on this kind of work and in repair work in general.

SPECIAL AND STANDARD MACHINES

The demand, created largely by the automobile industry, for machine tools intended for a few special operations—sometimes for one operation only—has greatly stimulated the production of such tools. In the near future, with keen competition and reduced prices, quantity production will be an important factor in lowering costs, and the demand for special machines to perform a single operation or series of operations will undoubtedly increase. There is a definite indication of this in the inquiries that have been received by the builders of special types of machine tools, especially in the milling, drilling, and multiple-spindle automatic machine fields.

On the other hand, what are generally known as standard machine tools—the engine lathe, turret lathe, milling machine, upright and radial drilling machine, planer, shaper and slotter, grinding machines of various standard types and a number of other machine tools in the same category, will always be in demand, because only a comparatively small portion of the entire machine shop work of the world can be done on the quantity production basis. Steam turbines and engines, large gas and oil engines, heavy mining machinery, large units of electrical machinery and many other types of machines and appliances cannot be built in quantities; and there are many machines that, while they will be built in fair-sized lots, will never be produced in such quantities as sewing machines, typewriters, cash registers or automobiles. Machine tools themselves are examples of this class. The special machine for producing in quantities, so effective in the automobile plant, would seldom be of service in a shop that produced machine tools only.

Both types of machines meet definite requirements, and while the present demand for special types appears to be better than for the standard machines, this does not indicate that the former are likely to replace the latter. Neither type really encroaches on the field of usefulness of the other.

* * *

ELECTRICAL DRILL STANDARDIZATION

Recent correspondence with a well-known manufacturer of machine shop accessories emphasizes the need for standardizing electric drilling equipment. It would be a decided advantage to all users of such equipment if manufacturers employed the same size and kind of fittings for attaching chucks of the same capacity. Instead of there being a standard means for doing this, some manufacturers use a taper arbor, while others employ a threaded spindle. A further advantage would be gained if drill chuck manufacturers would establish standards so that all drill chucks of the same capacity would have the same size recess to receive an arbor. This would relieve dealers from the necessity of carrying a large variety of arbors in stock and enable manufacturers to produce them in such quantities that they could be sold at lower prices. The user would gain added convenience from the interchangeability of different drill chucks, and the cost of the equipment would be less.

At this time, when production problems are not pressing, such changes involving a saving in time or money might well be considered by manufacturers. Their satisfactory solution would help the machine building industry and add another step toward the standardization of machine shop equipment.

National Machine Tool Builders' Convention

THE twentieth annual convention of the National Machine Tool Builders' Association, held in New York City October 18, 19, and 20, was unusually well attended, and a great deal of interest was displayed at all the sessions. The address by the president, August H. Tuechter, at the opening session covered many of the important questions now facing the machine tool industry. It reviewed the past history of the association and the business in the machine tool field, and contained much sound advice for the future.

The President's Address

In welcoming the members to the convention, Mr. Tuechter pointed out that he was called upon to preside at the most important annual meeting the association has ever held, because of the period of dullness through which the industry is passing. "We had four years of false prosperity," said Mr. Tuechter, "due to the war, when our industry was called on to increase its capacity and output far more than we ever dreamt possible. How well it met the call is a record to which we can point with pride. After the armistice, we had a slackening in business, which we rather expected, but to our surprise another period of false prosperity began in 1919. However, this did not last long, because new orders fell off from January, 1920, and kept slipping down until July, 1921."

In order to compare present conditions with those that the industry has passed through since the association was formed, extracts from the addresses of former presidents of the association at various conventions were read, dating back to 1904. From these extracts it was evident that during this period the machine tool industry has passed through a number of successive cycles of prosperity and depression in business. Seven slumps have been experienced in twenty-one years, and Mr. Tuechter expressed the hope that the mistakes made in the past in times of depression will not be repeated again, especially when the association now has in Mr. DuBrul, its general manager, an able advisor and competent observer who can give warning of shoals ahead and of clear sailing, and of the rise and fall of the business barometer. In this connection it was stated that the most promising and the most necessary activity in which the association is now engaged is the organization of the statistical service for each group of machine tools for which it is possible to render such service.

Waste in Industry

Mr. Tuechter referred to the Committee on Waste appointed by the Federated American Engineering Societies, the work of which has been to call public attention to the sources of waste in industry, and to arouse industrial leaders to the necessity and profit of eliminating waste. During the past year the association has assisted Fred J. Miller, formerly president of the American Society of Mechanical Engineers, in making studies of the machine-building industry. "This investigation," said Mr. Tuechter "seemed to show a probable waste of about 40 to 45 per cent. The report of the committee is very interesting, and it shows that in the machinery industry not a large proportion of this waste can be chargeable directly to labor restrictions; therefore, the responsibility for elimination of waste in the machinery business rests largely on the shoulders of management. There is a large excess of facilities that are not used to the fullest extent. There is badly planned management. Efficient planning and guidance of production is the duty of management; better employment service and policies lie within the power of management and not of the employes." The old proverb says that a dollar saved is a dollar earned, and Mr. Tuechter recommended to the members that they investigate every opportunity to save waste in their own shops, waste of every kind—in equipment, in time, in material, and in organization.

Uniform Cost Accounting

Another work carried on by the association during the past year is that relating to uniform cost accounting. It was advocated that this work be continued until the members all have some system of figuring the proper elements of cost. Unless this is done, there will be a false basis upon which false prices are founded. The man who does not charge enough into his costs is prone to make mistakes in his prices, although his cost system should automatically provide for the proper charges. Especial emphasis was placed on the point that a uniform plan should be used for calculating a normal burden, and that cash reserves should be put away in boom times to carry over depressions. If this had been done, the industry would be in a better condition than it now seems to be. The cost-accounting work, therefore, is one of the important phases of the association's activities.

Statistical Service

The statistical service recently organized was referred to in detail. A chart was shown, exhibiting the great irregularity to which the whole industry has been subjected, with an excessively high peak indicating the war activity; this peak showed that the number of machines manufactured at that time were something like 150 per cent in excess of the number manufactured at the most prosperous period previous to the war. It was pointed out how impossible it is to judge the wisest course from mere individual experience, and how much more accurately the future may be predicted if the information of manufacturers in regard to past business cycles is pooled in a statistical service. Other trade associations, it was said, have found this to be the most valuable service they can render their members, and Mr. Tuechter pointed out that the whole world gains much from the monthly reports of output that the iron industry has published for many years. All industry is closely related, and by proper study and interpretation of conditions it would be possible to better stabilize industry and to have ready for the consumer all the goods that he needs at any given time, at the same time avoiding an excess of goods when the consumer is not likely to need them. The individual manufacturer, confronted with a business situation such as the one through which we are now passing, is groping blindly, when guided only by his own knowledge and experience. He is much more subject to losses than if he had full information as to the total current output and sales of his particular product throughout the country, together with reliable information as to finished stock on hand, the amount in process, and the rate at which this stock is moving.

The statistical service of the association has already compiled figures of shipments of certain groups of machine tools for the last twenty years. The figures thus obtained make it possible to form quite a fair conclusion as to the pre-war trend, and in the light of that information an intelligent plan can be laid down for future policies. When complete monthly reports and charts are made out for each group, the actual flow of business can be easily seen, whether it is improving or falling off. Such statistics can be made of great value to the country at large, because it is evident that the slump in machine tools in any period of depression

precedes the decline in general business by several months and perhaps a year.

Standardization

Mr. Tuechter referred to the standardization work of the association in the following words: "For many years this association has talked about the possibilities of standardization. The time has now come to stop talking and go to work. The American Society of Mechanical Engineers has taken up a number of subjects that directly concern the machine tool builder, and we shall have to be represented on committees on these subjects. A recent letter from Mr. Einstein, chief engineer of the Cincinnati Milling Machine Co., who is now in Germany, says that the German machine tool builders are very busy with standardization work. Each committee should seriously and promptly formulate opinions as to what things can be standardized, and then go into the work of standardization.

"A general plan would be to have a general committee of the association which could make recommendations to the Engineering Standards Committee. Each machine group should have a special committee on standardization which would report its findings to the general committee. This is the practice of other organizations. We should take our proper position in these matters. If we do not do this work ourselves as affecting our own interests, we will have no just cause for complaint if others attempt to do it for us and do it badly, because of lack of understanding of our problems.

"We should not let the matter lie as we have heretofore, but we should make this a vital and active part of our association program. It will finally be a very profitable undertaking, as has been demonstrated by standardization work in other fields."

Report of the General Manager

The general manager of the association, Ernest F. DuBrul, presented a comprehensive report referring mainly to the statistical work that is being carried out by the association under his leadership. He emphasized the value of cooperation between the members, and between the members and the association's office. He outlined the methods used in distributing information and the value to the members of exchanging ideas. The bulletins sent out by the association to its members were referred to, and the value of the bulletins emphasized.

The main part of Mr. DuBrul's report, however, was devoted to the statistical work done by the general manager's office. In referring to this work, Mr. DuBrul reiterated the statements made by the president in his address. "It is well demonstrated," said Mr. DuBrul, "by many trade associations, that the most valuable service that can be rendered is to gather and distribute statistics of production, shipments, stocks, and sales. Without information of this sort, each manufacturer must simply grope blindly in the dark, making the wildest kind of guesses as to conditions that he must anticipate in the future. The poorer his information of a general situation, the worse his guess is likely to be.

"The first thing a man wants to know is whether he is getting his share of the business at any time. He can tell this if he knows the total number of machines in his line being sold in a month, and the total capacity of his group. If he knows that the present state of demand is only fifty machines a month, and that he is getting his share of that limited demand, he will not be tempted to do things that will compel his competitors to fight him, to his own detriment. But if he is ignorant of the facts, he is pretty sure to do something that will work against his own pocketbook. In no other way can he know, except by joining with his competitors in a composite report of conditions. When he has that report he can then compare his own conditions with those of the group as a whole.

"It is for the purpose of developing that sort of information for each group that we are organizing monthly statistical services of orders, concellations, production, shipments, factory stocks, and dealers' stocks for various groups. The groups who have already put this service into operation are the shaper, radial drilling machine and upright drilling machine groups.

"To give some groups a picture of their past, so that they can have a guide for the future, we have gathered statistics of shipments for the last twenty years. These are far from complete, but are fairly typical. The group charts show the situation not only for the group as a whole, but for the different sizes of machines made by the groups reporting."

The subject of how to provide a reliable and simple barometer of the machine tool industry that will indicate at all times with a fair degree of accuracy the conditions not only in the entire industry but in certain groups was dealt with in detail. Every industry should have such a barometer, and suggestions have been made both by Mr. DuBrul and by Mr. Charles Oesterlein, with a view to solving the problem in the machine tool building field.

Addresses Made at the Meeting

Charles L. Underhill, member of Congress from Massachusetts, made an able address on the subject "How Present Political Policies Affect Business," in which he pointed out the importance of business men and manufacturers taking an active interest in political matters, and informing their employes of business conditions and of the effect on their particular business of any political action. An address on "Business Cycles" was made by Professor David F. Jordan, which was followed by a discussion led by C. L. Cameron of Gould & Eberhardt, Newark, N. J., and by E. F. DuBrul. This discussion covered the questions: "What things should machine tool builders do?" and "What should they avoid at various stages of the business cycle?"

An address containing much information of value to machine tool builders was delivered by W. H. Rastall, chief of the Industrial Machinery Division of the Department of Commerce, Washington, D. C., on "The Orient as a Machine Tool Market." J. H. Drury, treasurer of the Union Twist Drill Co., Athol, Mass., spoke on "Conditions in Europe," giving his impressions from a recent business trip in several European countries.

At the meeting of the Executive Committee held Thursday morning, October 20, three questions were raised for general discussion, as follows: "What can be made in idle machine tool plants during times of slack demand for regular product?" introduced by H. L. Flather, treasurer of Flather & Co., Inc., Nashua, N. H.; "What reductions in prime costs may be expected in the machine tool industry during 1922?" introduced by P. M. Brotherhood, vice-president of Manning, Maxwell & Moore, Inc., New York City; and "Can sane methods be devised to grant long terms with proper credit guarantees or insurance in foreign trade?" introduced by J. E. Andress, secretary of the Barnes Drill Co., Rockford, Ill.

Officers of the Association for the Coming Year

The officers of the association were re-elected, but as the secretary Carl F. Dietz had resigned, Howard W. Dunbar, Norton Co., Worcester, Mass., was elected to fill his place. The other officers for the coming year are: President, August H. Tuechter, Cincinnati Bickford Tool Co., Cincinnati, Ohio; first vice-president, E. J. Kearney, Kearney & Trecker Corporation, Milwaukee, Wis.; second vice-president, C. Wood Walter, Cincinnati Milling Machine Co., Cincinnati, Ohio; and treasurer, Winslow Blanchard, Blanchard Machine Co., Cambridge, Mass. In addition, the following members were added to the executive committee: J. B. Doan, American Tool Works Co., Cincinnati, Ohio; C. E. Bilton, Bilton Machine Tool Co., Bridgeport, Conn.; and Fred L. Eberhardt, Gould & Eberhardt, Newark, N. J.

The British Machine Tool Industry

From MACHINERY'S Special Correspondent

London, October 12

AT the present time industry may be said to be trying to find its feet, a process that is bound to occupy some time, even though it is generally believed that many of the labor difficulties have been permanently relieved. The most serious barrier is the price of coal. The anxiety to start to produce is evidenced by the many inquiries that reach the machine tool makers. Even if some of these inquiries are merely for the purpose of sounding the market, it must still be assumed that there is a great deal of work ahead for the machine tool industries. Many of the machine tool makers are now building for stock, and most of them are of the opinion that the low point of the depression has been passed. Firms who specialize in jigs, fixtures, and tool lay-outs are busier than for months past, and this again must be construed as a hopeful sign, particularly as such orders generally point to a well defined manufacturing program on the part of the customer. Textile machinery manufacturers are becoming increasingly active.

A revival in the shipbuilding industry appears to be imminent, and there are indications that railway and locomotive building shops intend to resume buying. The latter continued to buy long after most of the other branches of the industry had gone out of the market. The main reasons for their withdrawing when they did were the instability of prices and lack of funds.

With regard to the automobile industry, most firms are working steadily, but the trade is seasonal, and an ebb invariably sets in about this time of the year and continues until after the automobile shows. The demand is more particularly for light cars, and various manufacturers, who previously have been exclusively engaged on the heavier and more expensive types, are making rapid progress in their arrangements to produce smaller models.

Another branch of the engineering industry that has maintained its activity is that specializing on marine Diesel engines. There are brisk inquiries for general brass-foundry work, for which Birmingham is world-renowned. The conclusion of the strike of joiners in the shipyards is good news for this industry, and it is hoped that many orders which have been held up by conditions in the shipbuilding trades will now be released.

One or two instances are noted where reductions of approximately 10 per cent have been effected in machine tool prices. While the recent reduction in wages is bound to have an ultimate effect on the price question, it requires some courage to begin cutting list prices, and makers prefer to quote on the conditions ruling at the time of the inquiry.

Overseas Trade in Machine Tools

There is a certain amount of business to be had in railway machine shop equipment for shipment to various European governments. The terms of payment, however, are such as to produce caution in booking orders. For example, the Bulgarian State Railways will pay only 10 per cent of the price on shipment, and the remainder after the machines are erected and satisfactorily at work in the shops. Orders for machine tools of the heavier types are coming more freely from Japanese sources, and India still continues to afford a profitable field to some British manufacturers of machine tools.

For the month of August the exports of machine tools amounted to £183,391, the tonnage being 1144. Although this showed a slight fall from the exports for July, the figures are exceptionally high as compared with imports, which again show a decided drop, reaching only £17,480 in value, for a tonnage of 65. The value per ton of imported machine tools rose from £166 in July to £269 in August, the value per ton of exports remaining fairly constant at about £160. The class of machine tools that represented the greatest export value was lathes, reaching a value of £54,000, spread over 192 machines. Drilling machines were exported in fairly large quantities and reached a value of £29,824, spread over 87 drilling machines. The only machines that in July compared somewhat nearly in value for exports and imports were grinding machines; the value of the imports was £4532 and of the exports £6448.

Developments in the Machine Tool Field

The practice of grinding the teeth of hardened gears is growing quite rapidly; one firm that makes a specialty of this work is the Gear Grinding Co., Ltd., of Birmingham. The method employed by this concern is to grind the wheel teeth with a grinding wheel dressed to the exact form of the tooth faces required. The wheel-dressing diamond is controlled from an enlarged form through a pantographic device. The indexing is by automatic means, and the machine will handle work up to 36 inches in diameter by 8 inches face. By the substitution of formers, teeth of any pitch or pressure angle, in either stub or full-tooth forms, can be ground accurately.

Thomas Shanks & Co., Ltd., Johnstone, Glasgow, have recently completed a very large machine for shipment to Japan. The machine is designed for turning very large gear blanks, and has a center height of from 110 to 123 inches, adjustable by means of packing blocks. The distance between centers is 40 feet, and the bed is 18 feet 6 inches wide. There are four saddles, each weighing 21 tons, and the total weight of the machine is 330 tons. The faceplate is 15 feet in diameter, and is capable of carrying parts weighing 100 tons. The main journal is 27 inches in diameter by 36 inches long.

Some large overhanging type hydraulic forging presses are being built by A. Rice & Co., Leeds, for the Great Indian Peninsula Railway. These presses have both vertical and horizontal rams, each of 200 tons, and the presses, except for the rams which are of cast iron, are built of cast-steel members. Hydraulic wheel presses have also recently been supplied by Messrs. Rice to the Polish Government railways. Two of these presses are for 7-foot wheels and exert a pressure of 300 tons.

A machine which has created a great deal of interest is a crankpin turning machine that has been developed by George Richards & Co., Ltd., Manchester. In this machine, the crankshaft is held rigidly while the tools rotate around the pin to be machined, and are held in a circular carriage that rotates in a housing through which the crankshaft is passed. The tools can be made to turn the full width of the pin at one cut, or narrower tools can be used and a traverse applied to the tool-holder housing. The feed of the tools is arranged in an unusual manner. An internally and externally cut gear ring is rotated differentially with the tool-holding ring, the difference in speed of the two resulting in advancing or withdrawing the tools, suitable gearing being provided to control the differential effect. The machine has been designed with the object of rapidly producing crankshafts with fairly inexpensive labor, but is said to be

capable at the same time of machining a crankpin to an accuracy of within one-quarter of a thousandth inch of size.

A grinding machine of considerable interest has been put on the market by Alfred Herbert Ltd. of Coventry. It is for the purpose of grinding cutting tools with a curved lip, so that a comparatively acute cutting angle can be obtained, with sufficient support to prevent crumbling. The machine uses a circular grinding wheel, and the tool is traversed below the wheel, the path of the tool relative to the wheel axis being variable so that the periphery of the wheel presents to the cutting tool anything from a straight line, through the whole range of ellipses, to a full circle. By using the extreme lower edge of the wheel, various forms of curve can be obtained behind the tool cutting edge.

A die-sinking machine built on rather novel lines has been designed by Bryant-Symons & Co., London. The work and a former to an enlarged scale are placed on a horizontal table, and above them are two vertical spindles, one carrying a tracer point and the other an end milling cutter. The spindle carriages are arranged on a horizontal arm, pivoted horizontally and vertically at one end of the machine, and arranged to be moved across the table by means of a rack and pinion, the relative position of the heads being controlled by a pantograph. The arrangement of the machine makes it equally suitable for die-sinking or profiling work, and cuts up to 0.3 inch deep can be taken.

J. Parkinson & Son, Shipley, are building for the market a Sunderland patent double-helical gear generator. These machines produce a continuous double-helical tooth without any finishing or correction by hand. The sizes of machines now in hand are for gears up to 3 inches in diameter by 10 inches face width, and for pitches up to 3 diametral pitch.

Prices of Materials

In the iron and steel trades, current demand shows only an insignificant improvement. Most of the works are getting their raw material from the Continent, some from Belgium, others from France and Luxemburg; and a certain proportion of the half-finished products which British manufacturers are working up comes from Germany. Home prices are approaching closer to foreign, but some materials, like wire rod, can be obtained cheaper from Germany.

Labor Conditions

The number of unemployed in the engineering and allied trades is approximately half a million, about one-third of the total number of unemployed in the country, and until some of the present handicaps to production are removed, it is not to be expected that conditions will improve. The cost of living is still a cause of grave dissatisfaction. Although it is generally admitted that the 12½ per cent war bonus must come off wages, it is the belief among those who should know, that the necessities of life could come down in price—thus offsetting the drop in wages—and still leave a reasonable profit. Retailers and middlemen in particular are blamed for profiteering on articles of food.

British Trade Ship

A project which is now receiving active attention is that of sending a trade ship to the principal ports of the world, carrying an exhibition of British manufactures. The ship will be called *British Industry*. She will have a gross tonnage of 20,000, and there will be eight decks, four of which will be devoted to the exhibition proper. The voyage will last about eighteen months.

PRICES OF BRITISH MACHINE TOOLS

Size	Price, £	Weight, Pounds	Price per Ton, £
Engine Lathes			
Swing, Inches			
12	105	.....	...
12½	160	1,400	256
12½	227	2,580	262
13	170	2,240	170
14	200	2,020	222
15	151	1,790	189
15	341	3,700	206
16½	336	4,700	160
17	295	4,260	155
17	347	5,150	151
17	340	6,160	124
26	400	7,840	114
26	862	14,560	133
29	670	......	...
30½	1010	21,280	106
Milling Machines			
Table Travel, Inches			
28	354	2,570	308
30	705	5,040	313
36	875	6,270	313
42	1036	8,960	258
Turret Lathes			
Swing, Inches			
16	824	5,260	351
20	938	6,380	329
Shapers			
Stroke, Inches			
9	110	1,570	157
16	200	2,460	182
16	383	8,400	102
16	175	3,140	125
16	160	2,800	128

Size	Price, £	Weight, Pounds	Price per Ton, £
Grinding Machines			
Inches			
10 by 24	458	3,250	315
12 by 36	720	6,830	240
12 by 24	462	3,580	290
Upright Drilling Machines			
Inches			
20	90	1,010	200
20	95	780	272
27	180	2,300	176
30	475	8,290	128
Radial Drilling Machines			
Radius, Ft. In.			
3 0	320	2,740	261
3 0	372	3,360	248
3 0	453	4,030	252
3 6	295	4,140	159
4 0	360	6,500	124
6 0	859	15,120	127
6 0	450	5,260	192
6 0	1390	18,480	169
Planers			
Feet			
1⅔ by 1⅔ by 4	258	3,470	167
2 by 2 by 6	250	6,720	83
2 by 2 by 6	370	5,600	148
2 by 2 by 8	450	9,180	110
2½ by 2½ by 6	474	8,400	126
3 by 3 by 8	628	11,540	122
3½ by 3½ by 8	826	17,920	103
4 by 4 by 10	1237	27,440	101
4 by 4 by 12	1100	32,480	76
4 by 4 by 16	1490	38,080	88
5 by 5 by 10	1847	45,360	91
6 by 6 by 10	2276	49,280	104

Machinery

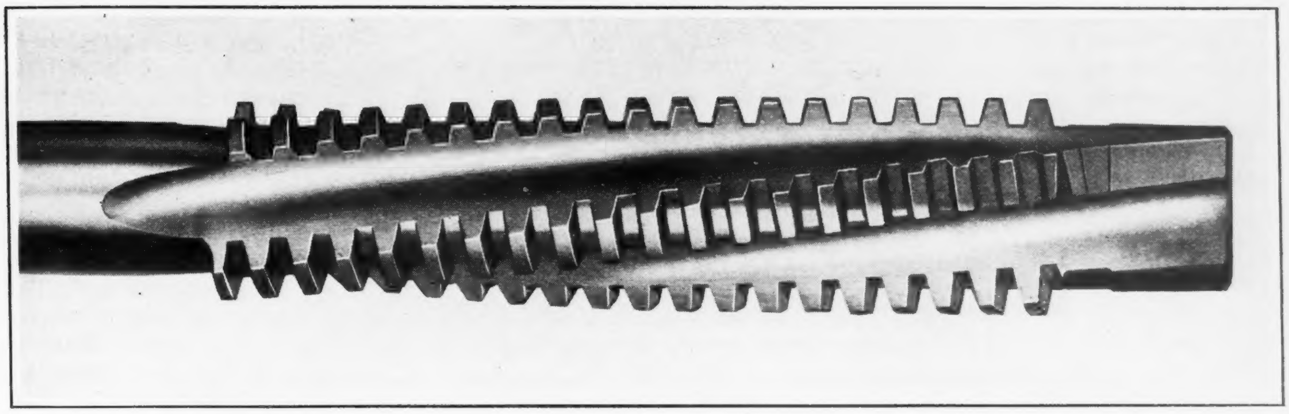


Fig. 1. Acme Double-thread Finishing Tap having Relief, Spiral Flutes, and Taper in the First Threads

Making an Accurate Acme Thread Nut

By B. M. W. HANSON, President, Hanson-Whitney Machine Co., Hartford, Conn.

THE Acme thread, as is well known, especially among machine tool builders, has practically replaced the square thread. It has proved to be the most efficient type of thread for such purposes as lead-screws on lathes and for screws employed for moving and adjusting slides on various kinds of machine tools, because it wears much better and it is more easily produced than other types of threads. If there is any criticism against the Acme thread it is on account of its large tolerance at the top and bottom of the thread, which is probably unnecessary. Half the tolerance would doubtless be sufficient for adjusting screws and slide screws.

Machine tools of the present day invariably have a micrometer dial on the adjusting screws; therefore these screws have in a way become micrometers, and if a machine tool is furnished with a combination adjusting screw and micrometer, it is important to have such a screw accurate and to make sure that it maintains its accuracy. The only practical way of maintaining the accuracy of the screw is to have a large bearing surface, properly lubricated, in the nut. In order to obtain a good wearing surface, it is necessary to make the nut long, and the best practice in modern machine tools is to have the nut as long as two diameters of the screw. In the majority of cases, there is no reason why a nut could not be made four diameters in length, provided the lead of the thread in the nut were the same as the lead of the thread on the screw. If such a nut were well lubricated and well protected from dust and grit, the wear would be reduced to a minimum and the accuracy of the screw would therefore be maintained for a long time.

Difficulty of Obtaining Proper Contact between Screw and Nut

On important work it has been found necessary to chase the thread in the nut, but if the nut is small in diameter in proportion to its length, it is not a very easy task to chase an accurate thread, and the practice in such cases is to finish the nut with a finishing tap. If the tap is not of accurate lead, however, it will not improve the thread in the nut, and although the screw may go through the nut and seemingly fit, it will actually bear on the end threads only and full contact between the screw and the nut will not be obtained until they have worn together, at which time the accuracy of the screw is gone.

If a machine tool were taken apart after having been used for a few months, when the screws were taken out of the nuts, which are usually made of bronze, it would be seen that the oil (if there is any) is yellow in color. The yellow color comes from particles worn away from the bronze nut, and even if the screw has been well lubricated there will be a considerable amount of bronze particles in the oil, mainly because there has not been proper contact between the thread of the screw and the thread in the nut, or because the nut is too short in proportion to the load it is working under. The writer's experience has been that there

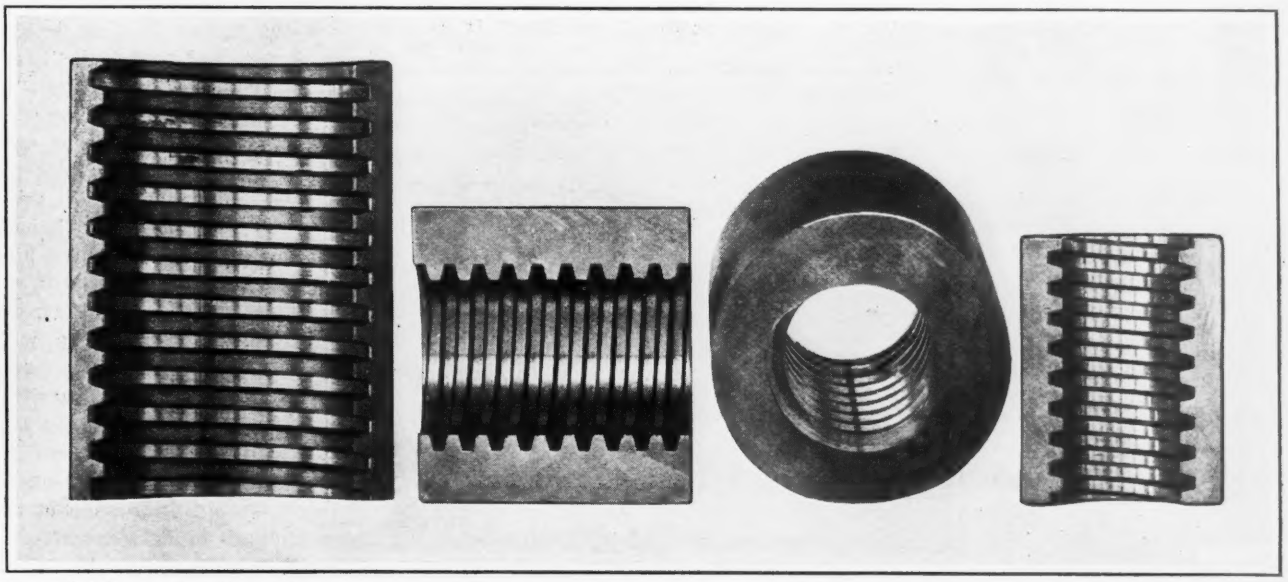


Fig. 2. Tapped Bronze Nuts of Fine Finish and Exceptionally Accurate Lead and Shape

has never been any proper means of producing an accurate nut, and although screws have been made very nearly accurate it has been a difficult matter to make nuts that fit them.

Use of Roughing and Finishing Taps

During the last few years the writer has made a great many experiments in an attempt to produce accurate threads in nuts, and after a comparatively short time was able to make taps of the U. S. standard form and the Whitworth form that are very accurate in lead and size, as described in the article "The Problem of Accurate Thread Cutting" in July MACHINERY. The Acme thread, however, presents other difficulties, as it is very much deeper in proportion and has a much slighter angle than the V-shaped threads have. Also, accuracy is of even greater importance in places where Acme threads are used.

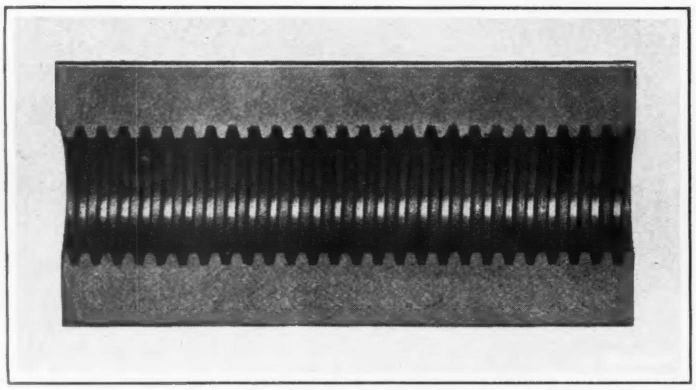


Fig. 3. Tapped Cast-iron Nut, 6 Inches Long, with Thread of very Accurate Lead

After making a good many sets of taps of different forms, clearances, shapes of flutes, and different proportions for removing stock quickly, the following method has finally been adopted: One or more roughing taps are made according to the length of nut and depth of thread. The roughing tap leaves the thread almost the full diameter and too wide, which is the same as making the space between the threads too narrow. Next a finishing tap is made, having the proper clearance and a thread on the end narrow enough to enter the nut. The width of the thread is gradually increased by making the tap gradually larger in diameter in the angle of the thread; the threads are also stepped by proper amounts to give the chips the proper thickness, and the straight part of the tap is not made longer than twice its diameter. This tap is finished to accurate diameter and lead after hardening. By this method it is possible to obtain a finished thread in a nut that will fit an accurately made gage. The thread will have a mirror-like finish.

Experiments have been made in bronze, cast iron, and machine steel, and it is possible to produce a finish in any of these materials that is surprisingly fine, as well as to maintain a lead in which it is very hard to detect any error. Figs. 2 and 3 show nuts that have been cut in half, but one must see the actual work to appreciate fully its fine finish. As a general rule, it is possible to obtain these results with one roughing tap and one finishing tap, but a combination roughing and finishing tap has also been made which gives excellent results. It is merely a matter of economy as to whether one or more taps should be used. One of the finishing taps is shown in Fig. 1.

Lubrication when Tapping

Ideas vary as to the lubricants to use when tapping different materials. For steel it is generally accepted that lard oil or sperm oil is best when using small taps. After several weeks of experimenting with different taps, accurately made, having different clearances and different thicknesses of chips for each tooth, it was found that in tapping cast iron, steel, and bronze, good lard oil gives the best results.

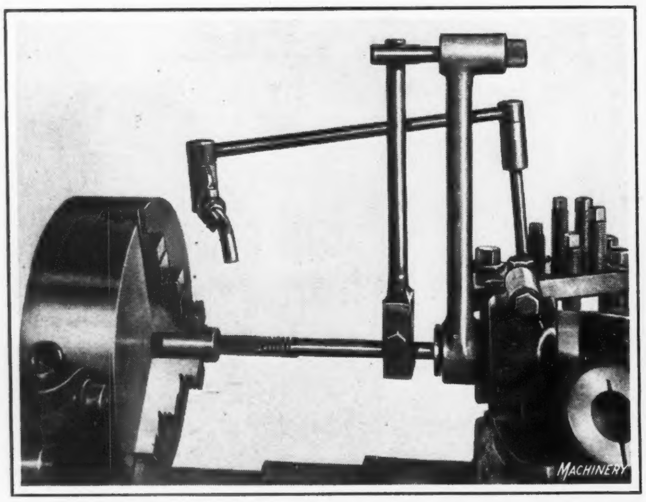


Fig. 4. Floating Tap-holder for Turret Lathe

Nuts were tapped in cast iron with taps $1\frac{1}{4}$ inches in diameter and 6 inches long, using a copious stream of lard oil. The tapping was done in a turret lathe. Excellent results were obtained, and the temperature of the piece being tapped, as well as of the taps, was very little different from what it was before tapping. Hundreds of nuts were tapped in this way out of different materials, and different clearances or reliefs were provided on the taps to see which produced the smoothest work and operated the easiest. Although it is possible to improve the results by varying the clearance on the tap according to the material to be tapped, an average clearance can be provided which will be satisfactory for almost any material. It was found that the thickness of chips that each tooth was taking with a reasonable relief and proper lubrication made a combination that always produces good results.

In making an Acme tap in the old way, that is, by finishing it first and hardening it afterward, no matter how much care has been taken to see that each tooth takes the correct thickness of chip, the chip thickness will vary after the tap has been hardened. It will be found that thick chips and scrapings are produced and that most of the chips are in two flutes, whereas with an accurately made Acme tap that has been finished and corrected after hardening, the chips will be of uniform thickness and shape, and the same amount of chips will be found in each flute. Even in tapping cast iron with an accurately finished tap, the chips will be distinctly curved, about the same as when turning cast iron with a tool that has a certain amount of rake.

Acme screws are often made double-thread or even triple- and quadruple-thread, so the lead angle in such a thread is considerable. Every mechanic knows the difficulty of tapping holes with a thread of this kind, but by properly designing the tap and making the flutes of such a spiral that they will be at right angles to the tap teeth, the tap will work practically as easily as a single-thread tap. With tools of this kind it has been fully demonstrated that not only extremely accurate work can be done, but that the work can also be done with a large saving of time. Nuts such as shown in Figs. 2 and 3 have been produced in a few minutes.

Holding an Acme Tap in a Turret Lathe

A turret lathe is a convenient machine to use in tapping Acme nuts. It generally has the proper holding devices, power, and good facilities for lubrication. In using the roughing tap, unless the operator is very skillful and careful he is likely to ream the hole before the tap takes hold, and this may happen even after the tap takes hold if it is rigidly fastened in the turret, as it is difficult for the operator to follow up with the turret-slide at the same speed as the tap is traveling. If he pushes too hard, he will widen the thread, and the same thing will take place if he retards the motion of the slide; if he does not attempt to follow up with the turret-slide, the tap will have to

drag the slide along, and this will also cause the thread to be widened.

It is important that a roughing tap should not cut the thread (or rather the space between the threads) too wide, because in that case there would not be enough metal for the finishing tap to remove. The roughed out thread, as previously stated, should be wider than the finished thread. Fig. 4 shows a floating holder used to hold an Acme tap in a turret lathe. It will be seen that with this device a tap will be allowed to make its own lead without having to drag the turret-slide along or without it being necessary for the operator to try to follow up the lead except roughly.

The shank of the tap in this holder has a free running fit in the bushing, and the wrench-shaped arm which fits the flats of the tap shank rests against a pin in the stationary arm of the holder. This prevents the tap from turning around, but the shank can slide in and out in the bushing, and if the arm is 12 inches long from the contact point of the rod to the center of the shank, the pressure on the outer end of the arm will be approximately one-twelfth of what it would be if the tap were held rigidly by the ordinary square at the end of the shank. Therefore it is possible for the tap to float in and out while sliding on the arm, which has a reduced pressure contact. With this device it is only necessary for the operator to follow up with the turret-slide so that the arm does not slide off the rod, and hence the tap has very little chance of dragging so as to widen the space between the threads.

When the finishing tap is used, the operator proceeds in the same way, except that he turns the finishing tap in by hand until the sides of the thread of the tap are in contact with the walls of the roughed out thread. Acme taps of the type described in the preceding are manufactured by the Hartford Tap & Gauge Co., of Hartford, Conn.

* * *

SOUTH AMERICAN TRADE

Efforts are being made to re-establish American business relations with South America, a thing difficult to do because of conditions developed during the war and the present disadvantage of an unfavorable money exchange which protects the European trade in South America against American exports. The American Trade Bureau, in the interest of which Colonel S. Graae has recently sailed for South America, in order to organize trade connections, states that the real difficulties to be overcome are those due to the lack of harmonious understanding between American representatives in South America and South American business men, the insufficient support given by the banks, and last but not least, the fact that the Latin business men have not always been handled with that diplomacy and tact which is one of the main factors leading to success in doing business in South America. The European countries, according to Colonel Graae, are daily progressing in South America, not only because the exchange rate is in their favor, but because they have thoroughly studied the customs of the Latin race and won their confidence. With the quality of goods that America can offer, the right kind of trade representation would assure success.

Care in relation to certain apparently minor details is often the means of securing the good will of South American concerns, as, for example, in the matter of postage. In this connection attention is called to the recommendation of Commercial Attaché W. L. Schurz, of Rio de Janeiro, that American manufacturers should discontinue sending heavy catalogues to South America by parcel post. Such publications should be sent by express, or by any other means available. A large number of packages sent by parcel post are piled up in the custom-house at Rio de Janeiro, and it requires so much time and expense to get a package out of the parcel-post section of the customs that many persons prefer to leave their packages unclaimed.

INDUSTRIAL CONDITIONS IN FRANCE

By MACHINERY'S Special Correspondent

Paris, October 11

Orders for machine tools are few and, as a result, French builders of machine shop equipment are producing far below their normal capacity. Because of this low production, the costs of machine tools have increased considerably. This market is also flooded with the stocks of importers, and with machines purchased by the various government bureaus for the devastated regions, and machines coming from Germany. The selling season for agricultural machinery which is now being terminated has been rather good, the sales at least equalling, and possibly surpassing, those of the same period in 1920. The market for this class of machines remained firm throughout the whole season, but a certain quantity of left-over agricultural machinery can be obtained at the present time at reduced prices.

Improvements in Various Fields

In the automobile field the situation has improved slightly, although, as yet, there is but a limited activity in most plants. The Peugeot plant produces 700 automobiles and 250 motorcycles a month; it also produces 9000 bicycles. Another automobile manufacturer near Paris produces 200 16-horsepower cars per month and an equal number of smaller cars. The accessory manufacturers state that their business is fair.

During the last few weeks the makers of aviation products have begun producing to a slight extent, a few orders having been received from foreign governments and private sources. Another noteworthy order is that of the War Department for 150,000 sets of special breathing apparatus, which will be filled by Leconge & Willmann. The order amounts to 5,025,000 francs (about $366,000, present exchange).

There has been a slight improvement in the iron and steel field. Buyers have decided to place orders while the market remains firm, because they fear an increase in the cost of raw material which would, of course, cause prices to rise. Conditions, however, are far from what could be considered normal. Good quality scrap iron and iron castings are still in demand, principally for export, a large quantity being bought by Belgian dealers and destined principally for Germany. In northern France and in the vicinity of Paris, the market for scrap iron has also improved.

There has been a decided improvement in the bolt and nut field. Conditions in this field are different from those in other branches of the metal-working industry, as no scale of production is fixed by organized labor, and this leaves the manufacturer free to reduce production costs and quote prices accordingly. Prices have been reduced, and although they do not yet seem stable, further large reductions are not anticipated. It is interesting to note the wide variation in prices of the past week. An offer for 810 metric tons of bolts was accepted at 65.6 francs per 100 kilograms ($2.12 per 100 pounds, present exchange) while another offer for 37 metric tons of bolts at 121.9 francs per 100 kilograms ($4.02 per 100 pounds) was rejected.

Labor Conditions

There is no indication of an ending of the strikes in the textile industry in northern France, as neither side seems willing to modify its viewpoint. It is believed that, due to the instability of prices of raw materials, the owners are not anxious to resume operation. The workers in the iron and steel field have also declared a strike to show their strength, but it is thought that this strike will be of short duration. Labor conditions in the rest of France are quiet, except for some slight disturbances occasioned by reductions in wages. The slight improvement in the manufacturing field has contributed toward decreasing the number of unemployed.

American Gear Manufacturers' Convention

THE fall convention of the American Gear Manufacturers' Association, held in Rochester October 13 to 15, was largely attended, and the program was crowded with important reports on gear standardization. The meeting was opened by a welcome to Rochester by Andrew C. Gleason of the Gleason Works, after which the president of the association, F. W. Sinram, of the Van Dorn & Dutton Co., Cleveland, Ohio, in brief opening remarks gave voice to the conviction that the lowest point had been reached in the industrial depression, and that industry is now on the upgrade. Two new member companies were elected, the Central Products Co., of Detroit, Mich., and the Harris Engineering Co., of Bridgeport, Conn. The association now has 94 member companies, 112 executive members, and 61 associate members. The extent of the industry represented by the association may be estimated from the fact that reports from less than half of the member companies show that they employ together nearly 20,000 men.

Papers Read before the Convention

Several papers of direct interest to the gearing industry were read before the convention. S. O. White, chief engineer of the Warner Gear Co., Muncie, Ind., read a paper on "Gear Tooth Wear," reviewing some valuable experiments that have been made in the laboratory of that company, relating to the wear of gears made from different materials and heat-treated in different ways. This paper also indicated the remarkably high efficiency that may be expected from gearing properly cut and heat-treated—96½ per cent in the case of a train of four spur gears.

A comprehensive paper on "Duralumin as a Material for Worm and Other Gearing" was read by R. W. Daniels of the Baush Machine Tool Co., Springfield, Mass., and one on "Tooth Forms" by E. W. Miller, chief engineer of the Fellows Gear Shaper Co., Springfield, Vt. Abstracts of these papers will appear in a coming number of MACHINERY. An address was also made by E. S. Sawtelle, assistant general manager of the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, entitled "First-hand Impressions of Europe," in which Mr. Sawtelle related some interesting experiences and impressions from his visit to Europe this summer.

The Society's Standardization Work

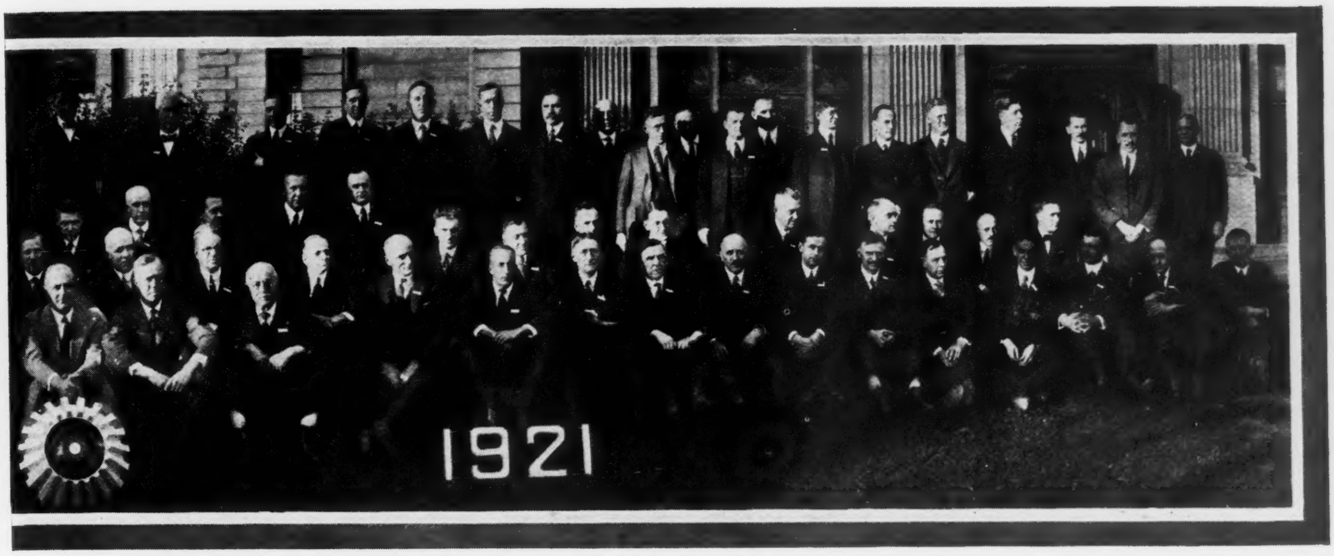
The most important part of the society's work is that of standardization in the gearing field. The society has already dealt with a number of the important phases of the work met with in the gear-cutting industry, and has made great headway in the direction of standardization, but until recently there has been no comprehensive standardization program that would act as a complete guide for the entire work of the association in this direction. Hence, at a meeting of the members of the General Standardization Committee held last summer, a definite standardization program was adopted with the idea that by having such a program constantly before the association, better aid could be obtained by the committees from the members. As no standardization in gearing has been attempted in this country up to this time, except by the American Gear Manufacturers' Association, the objects of the standardization activities of the association will doubtless be of interest to the entire mechanical engineering industry. The program laid out by the association is therefore partly republished, in order that the cooperation of engineers everywhere may be obtained—a factor essential in any real standardization work in this field. Those who may desire to communicate with the association in connection with the standardization program should address B. F. Waterman, chairman of the General Standardization Committee, American Gear Manufacturers' Association, Brown & Sharpe Mfg. Co., Providence, R. I.

Standardization of Spur Gears

The objects of the Committee for the Standardization of Spur Gears are as follows: (1) Nomenclature and symbols in conjunction with the Nomenclature Committee; (2) preparation of a standard spur gear for general industrial use, by means of a diagrammatic illustration of various types of spur gears, including a spoked wheel, a webbed wheel, and a solid pinion, with proper formulas covering width of face, rim, arm proportions, and hub proportions, in conjunction with the other committees; (3) development of general horsepower formulas with the view of developing tables for horsepowers; (4) investigation of allowable stresses for A. G. M. A. materials in connection with the Metallurgical Committee; (5) arrangement of means for communicating with the general membership regarding gear installations (using standard chart) to determine the proper design of gear sets and gear mountings under various conditions; (6) standardization of automotive spur gears, as to tooth forms, form of blank, horsepower, wear of teeth, method of mounting, stiffness of shafts, clearance, materials, tolerances, lubrication, etc.; (7) cooperation with Committee on Tooth Form to standardize spur gear tooth forms; (8) inspection.

Standardization of Bevel Gearing

This committee will take up the following subjects: (1) Nomenclature, symbols, and formulas in conjunction with the Nomenclature Committee: (2) materials—all kinds to



be considered in conjunction with the Metallurgical Committee; (3) mounting of bevel gears, location of bearings in the surrounding case, or supports and lubrication; (4) bores and their relation to diameter of gear; (5) keyways; (6) radial and thrust loads—method of calculation and their relation to strength and wear; (7) backlash for various conditions of service; (8) bottom clearance; (9) tolerances for blank gear and teeth; (10) length of face and its effect on strength and wear; (11) tooth form and addenda proportions (generated gears, form planed gears); (12) thickness of teeth; (13) strength—rules for horsepower; (14) wear of teeth; (15) heat-treatment in conjunction with the Metallurgical Committee; (16) inspection in conjunction with the Inspection Committee; (17) body proportion (arms, web, and hub) in conjunction with other committees; (18) accumulation of records of successful and unsuccessful bevel gear drives transmitting limiting power, using standard chart for the purpose.

Standardization of Worm-gearing

(1) Nomenclature, definitions, abbreviations, symbols, and formulas in cooperation with the Nomenclature Committee; (2) materials for worm and wheel and heat-treatment in conjunction with the Metallurgical Committee; (3) recommendations for the best sizes of worms for each pitch and style (hole or shaft worms) to reduce the number of sizes to a minimum; (These will cover worms for industrial and automotive use, and tables or lists of the recommended sizes will be compiled.) (4) compromise in a commercial, practical, and scientific manner, the various factors which affect the practical use, manufacture and efficiency of worm-gearing; (5) recommendations for the design of worm-gears for all kinds of service, and their mounting and housing; (6) strength or load-carrying capacity—horsepower rules—method of calculating tooth and bearing pressures; (7) tooth form and proportions for various applications; (8) wear of teeth; (9) design of body of worm-wheel (arms, web, hub) in conjunction with the other committees; (10) accumulation of records of successful and unsuccessful worm-gear drives transmitting limiting loads, using standard chart for the purpose; (11) inspection in conjunction with the Inspection Committee; (12) recommendations as to the design of the worm-wheel to enable the present existing hobs to be used to best advantage. Such items as material, blank proportions, tooth pressures, bearing loads, mounting and lubrication will be considered.

Standardization of Herringbone Gearing

(1) Nomenclature, symbols, and formulas; (2) most suitable spiral angle (of teeth with axis), pressure angle; (3) rules for calculating diameters for various ratios of hobbed gears where corrections are made for under-cut; (4) width and depth of groove in center of face for solid blanks or rims for different methods of hobbing; (5) formulas for strength (horsepower, using safe working stresses of A. G. M. A. materials); (6) recommendations for the use of standard (stock) 14½-degree pressure angle hobs. Method of calculating blank diameters; (7) design of gears and mountings; (8) accumulation of records of successful and unsuccessful installations to determine the proper design of gear sets and mountings, using standard chart for the purpose; (9) inspection.

Standardization of Keyways

(1) Recommendations for suitable sizes of keyways for various shaft sizes; (2) keyway-stock sizes and materials; (3) review of existing splined shaft standards with the object of recommending more suitable limits and tolerances; (4) consideration of keyways now recommended for special purposes; (5) cooperation with committees of other organizations now considering keyways; (6) consideration of key strength; (7) tables showing depth of vertical wall for keyway sizes recommended; (8) methods of inspection.

Standardization of Tooth Forms

(1) Nomenclature, symbols, and definitions, in cooperation with the Nomenclature Committee; (2) recommended standard tooth form (to include pressure angle, addendum, whole depth of tooth, clearance, fillet, and backlash); (3) stub tooth standard; (4) investigation and comparison of the merits of teeth having equal addendum and dedendum with those having a long addendum for the driver; (5) methods of inspecting tooth forms.

Standardization of Inspection Methods

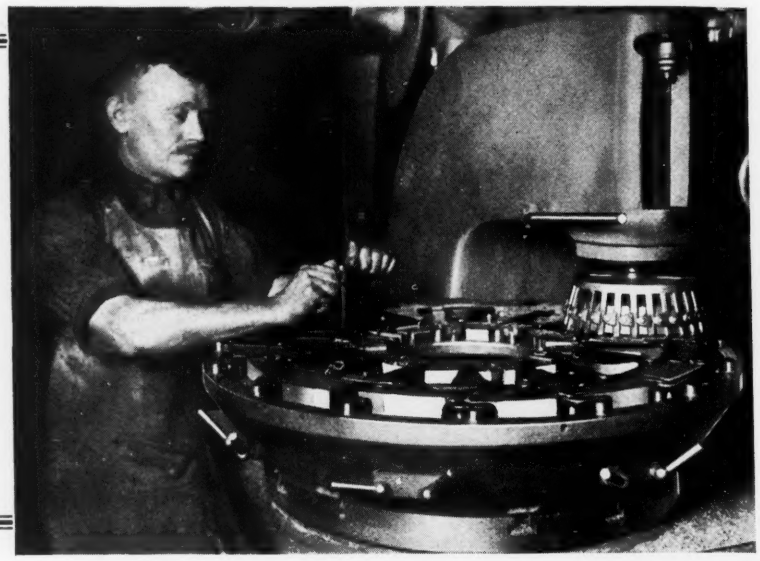
(1) Methods of inspecting gears, testing machines, etc.; (2) inspection of threads, in conjunction with other interested organizations; (3) inspection of raw materials in conjunction with the Metallurgical Committee; (4) inspection of hobs and cutters; (5) investigation of possible methods of determining the degree of gear noise.

Standardization Reports Accepted at the Meeting

The committee on gears and pinions for electric railway service presented a report which was accepted as recommended practice for the members of the association. The Metallurgical Standardization Committee also presented a report covering forged or rolled steels, brass, and bronze, and steel castings, which was accepted as recommended practice. Another report also accepted at the meeting covered sprocket wheels and chains.

Friday afternoon, October 14, the representatives and guests present at the convention were invited to the Gleason Works for luncheon, which was followed by an inspection of the plant. Saturday afternoon the members and guests were again the guests of the Gleason Works at a clambake at Corbetts Glen, a short distance from Rochester.

Reducing Costs by Rotary Milling



Examples of Work Advantageously Handled on Becker Vertical Rotary Milling Machines

METHODS that open the way to higher production, particularly those that employ standard machine tool equipment, are essentially cost-reducing methods. A number of representative examples of parts which have been machined on the Becker rotary type of milling machine at a saving in production time are cited in the following, and data furnished regarding the equipment used and the time consumed.

The first job to which attention is directed is that of milling the interior bearing surfaces of a 48-inch solid truck tire mold, and the set-up used is illustrated in Fig. 1. The steel casting is shown strapped to a special table, which for this job is substituted for the regular machine table. This table is tapped for a number of long tie-rods so that the deep casting, which is 12 inches wide on the tread, may be conveniently held down. A special high-speed end-mill extending the full depth of the casting is used, and it is driven at 45 revolutions per minute, which is equivalent to a cutting speed of 30 feet per minute. The depth of cut is 3/8 inch, and the time required to complete this operation is forty-five minutes—ten minutes of which is required to set up the work. In locating the steel casting centrally, use is made of a stud assembled in the center of the special table. A radial arm is fitted to this stud, the arm being swung about this center to quickly and effectively centralize the casting.

The particular point of interest in the set-up shown in Fig. 2 is the multiple fixture employed. This fixture has eighteen loading stations, in each of which two pieces of work are carried. The stations in the lower and upper parts of the fixture are staggered relative to each other, as a means of relieving the strains set up by the cutters. The parts to be machined are small drop-forged steel yokes, and the clamping element is so devised that a pair of yokes is located by one stop at each station between the two parts, and also each pair of yokes, when thus located, is secured by a single strap and bolt. This makes a very convenient arrangement for loading the fixture, and a quickly operated one. Two special double-staggered inserted-tooth milling cutters, 7 inches in diameter, are used, which work at a cutting speed of approximately 55 feet per minute. It will be seen that the lower end of the cutter-spindle is provided with a bearing, which prevents the spindle from springing out of alignment due to the stress set up by the cutters, thus safeguarding against inaccuracies resulting from this cause. The table feed is 2 inches per minute and the production rate is ninety drop-forgings per hour.

Milling Operations on Rotary Worm-gear for Milling Machines

Figs. 3 to 6, inclusive, show set-ups for the various operations required to machine a rotary worm-gear used on Becker vertical milling machines, prior to cutting the teeth. The first operation, Fig. 3, is the taking of a surfacing cut on one side, this surface being used as a locating surface in later operations. This worm-gear is made of cast iron, and is 28 inches in diameter. The cutter used is an 8-inch high-speed inserted-tooth face mill, which takes a cut 1/4 inch deep over a surface of 7 inches wide. The cutter revolves at 30 revolutions per minute, which is equivalent to a cutting speed of about 60 surface feet per minute. The table feed is 6 inches per minute, and the cutting time twelve minutes, exclusive of the six minutes required to set up the work. It will be noted that no special equipment is required to hold the gear blank, ordinary screw-operated clamping jaws being employed for this purpose.

In the second operation, which is set up as shown in Fig. 4, the work is reversed and strapped securely to the table, being located by the previously milled face. The operation illustrated is the milling of a 30-degree beveled surface in two cuts, using a 60-degree high-speed angle cutter. The depth of the roughing cut is 1/8 inch, during which operation the cutter revolves at 40 revolutions per minute, using a table feed of 10 inches per minute. During the finishing cut the same table feed is employed, but the rotative speed of the cutter is increased to 50 revolutions per minute. The setting up time is from six to seven minutes, and the actual cutting time eleven minutes for the roughing cut, and from nine to ten minutes for the finishing cut, making a total time of about twenty-seven minutes per casting. There is no setting up time included in the finishing operation, it being unnecessary, of course, to reset the work.

It is a generally recognized principle in machine shop practice, and particularly in the manufacture of parts in quantity, that any method that permits the cutting tools to operate continuously upon the work while the loading and unloading of jigs and fixtures is done with the machine in operation, adds greatly to the economy with which the machining can be performed. One of the best examples of this principle of manufacturing is found in the application of rotary milling, and advantage is being taken of the savings made possible by this process of machining to an ever-increasing extent. In quantity production, the rotary milling process has been found to be a valuable means of reducing costs.

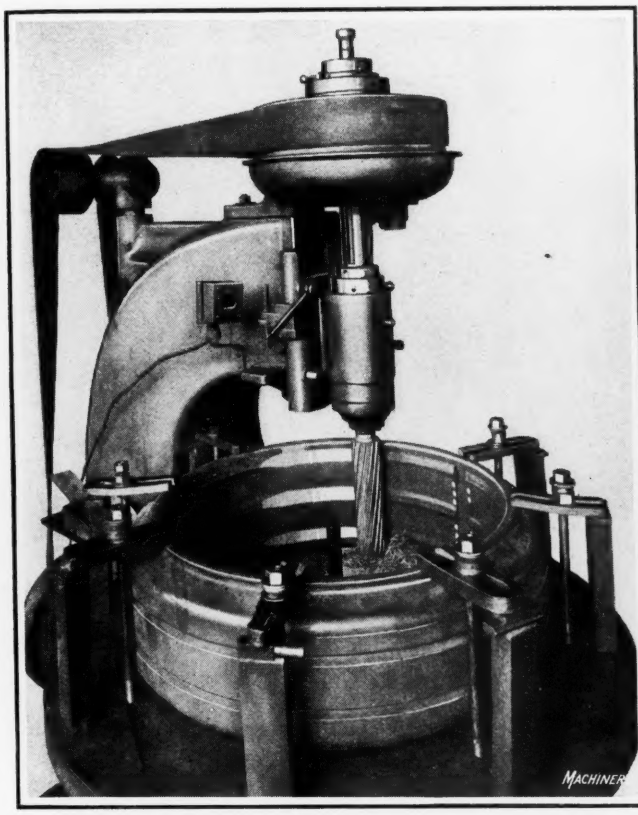


Fig. 1. Vertical Rotary Milling Machine set up for milling Truck Tire Molds

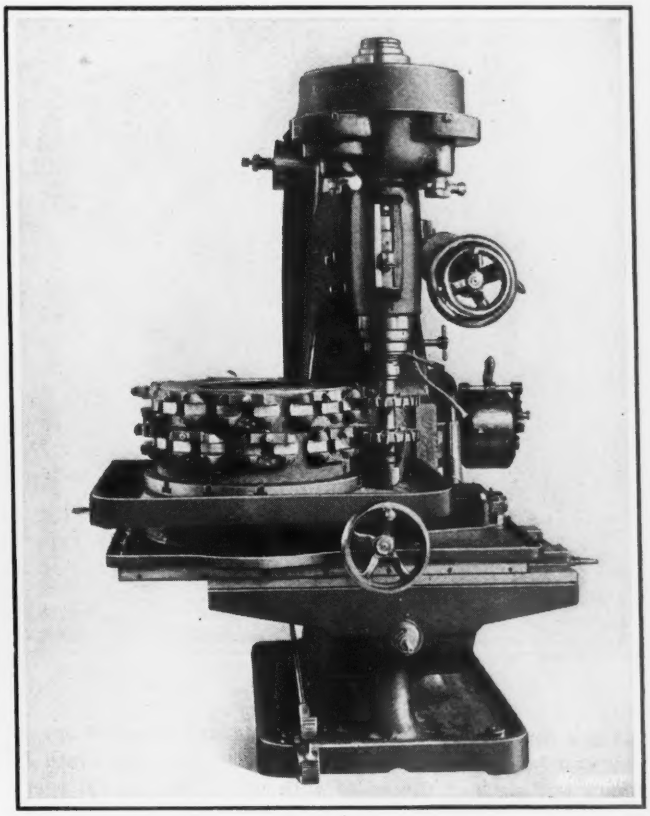


Fig. 2. Straddle-milling Yokes, using a Continuous Rotary Milling Fixture

The third operation on the worm-gear blanks is milling the outside diameter to 18 inches, the work being located in the same position as in the previous operation, as shown in Fig. 5 and the only work required in resetting being simply the changing of the position of the clamps so as not to interfere with the passage of the cutter during the cut. A 2½- by 3-inch high-speed face milling cutter is used and the depth of cut required to finish the castings to the specified outside diameter is 3/16 inch. The cutter revolves at 45 revolutions per minute, or at a cutting speed of about 30 surface feet per minute. The table is fed at the rate of 8 inches per minute, and the approximate time for completing the operation is eleven minutes per casting. It has been estimated that this job would consume about twenty-five minutes if machined by turning in a lathe.

Fig. 6 illustrates the final milling machine set-up required to rough out the blanks, and consists of milling the groove in which the teeth are finally cut. In changing from the third operation to this, it is only necessary to change the cutter and set the table over to give a depth of cut of 7/16 inch, and then proceed without changing the work from the position occupied in the previous operation. A special high-speed steel form cutter is employed which works at 45 revolutions per minute, in conjunction with a table feed of 6 inches per minute. The production time is twelve minutes per casting. The outstanding features of

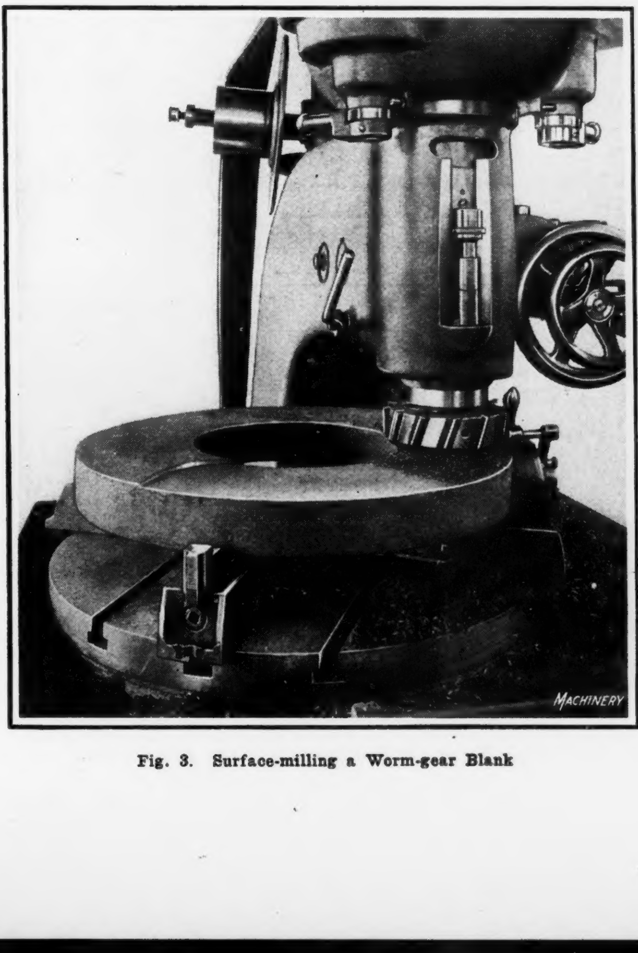


Fig. 3. Surface-milling a Worm-gear Blank

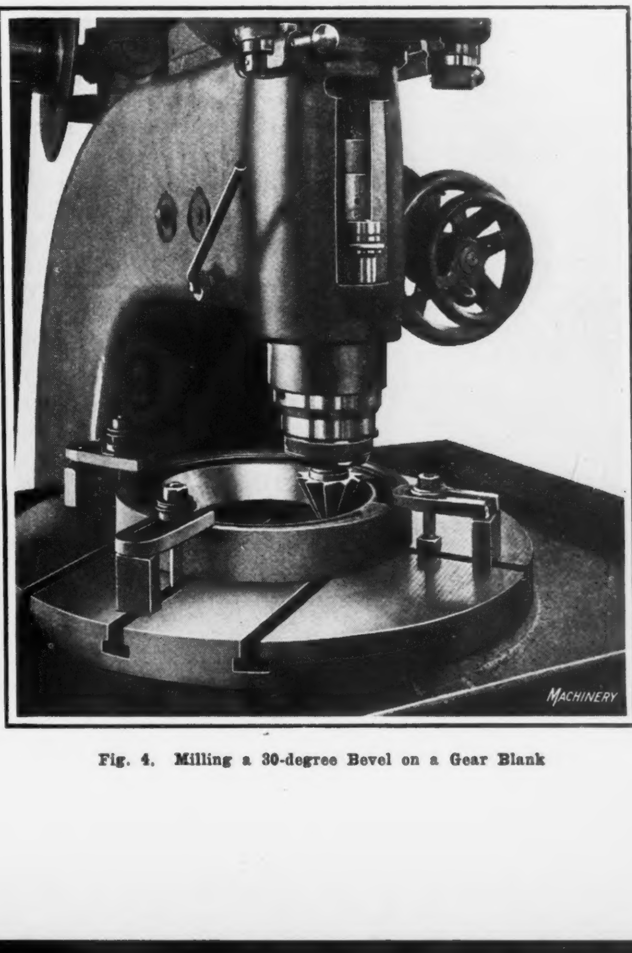


Fig. 4. Milling a 30-degree Bevel on a Gear Blank

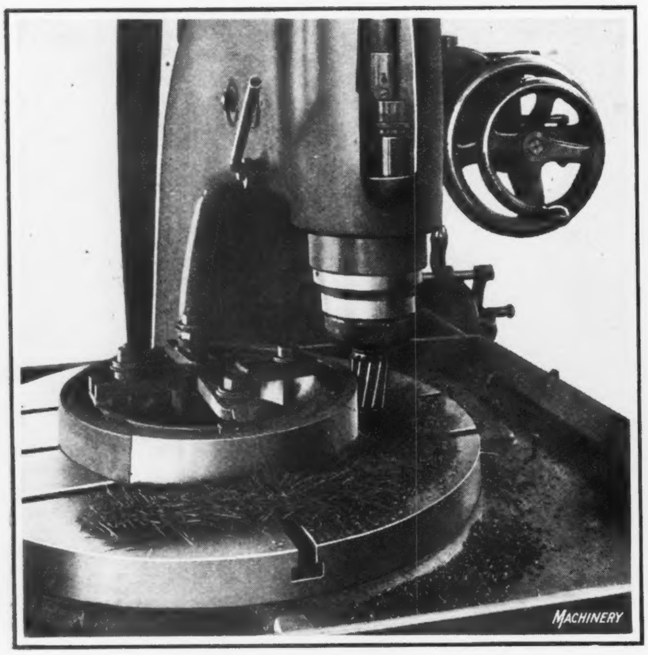


Fig. 5. Milling Outside Diameter of Gear Blank

Fig. 6. Milling the Groove for the Gear Teeth

the job just described are the simple and effective means that can be employed for holding work when machined by rotary milling, and the speed with which the several operations may be completed.

Milling Crane Sheaves

Three operations are performed on cable sheaves for hoists and cranes by means of the application of the vertical rotary milling method. These three operations are shown in Figs. 7, 8, and 9. In the first operation, the outside diameter is milled to form the groove where the cable operates, and the rim is straddle-faced. A gang of three milling cutters is employed—a form cutter for the groove and two inserted-tooth face milling cutters for straddle-milling the rim. The sheaves are steel castings, and are machined as described, with the set-up illustrated in Fig. 7, in thirty minutes, exclusive of setting up time.

The work is located on a special fixture attached to the table of the machine, the fixture being provided with elevating blocks for holding the work sufficiently above the base of the fixture to allow operating space for the lower straddle milling cutter. The three blocks by means of which the sheave is thus elevated carry a pair of clamping bolts each, their location being such that a strap may be used over every other arm of the sheave to clamp the work down by means of the bolts. This arrangement is shown in the illustration. The side milling cutters are 8 inches in diameter, and the form cutter 6 inches in diameter. The cutters revolve at 28 revolutions per minute, or at a cutting speed of approximately 44 feet per minute. The rate of table feed is 3 inches per minute.

The second operation on the sheaves consists of boring a 6¾-inch hole in the top of the sheave, as illustrated in Fig. 8. The work is located in the same manner as in the first operation, there being a substantial fly-cutter substituted for the milling cutter. A roughing and a finishing cut are required to machine this hole, in the first of which ¼ inch of stock is removed. The cutter speed is 28 revolutions per minute, and the rate of feed is ¼ inch per minute. It will be understood, of course, that this feed does not apply to the rotation of the milling machine table, as in previous operations, but rather to the vertical feed of the machine spindle. The time required to complete this operation is twenty-four minutes.

The third and last milling operation on these sheaves is illustrated in Fig. 9. The operation consists of straddle-milling the faces of the hub, using two side-milling cutters of 6 inches diameter. The milling machine spindle is fed down by hand until the lower cutter has passed through the bored hole in the hub to a sufficient depth to bring the two cutters into the proper vertical relation with the surfaces to be faced. The table of the machine is then fed over so that the center of the spindle is eccentric relative to the center of the bored hole, thus enabling the cutter to extend beyond the outside diameter of the hub. The spindle speed is 36 revolutions per minute, the table feed is 2 inches per minute, and the depth of cut, ⅜ inch. The time required to straddle-mill a sheave is fifteen minutes.

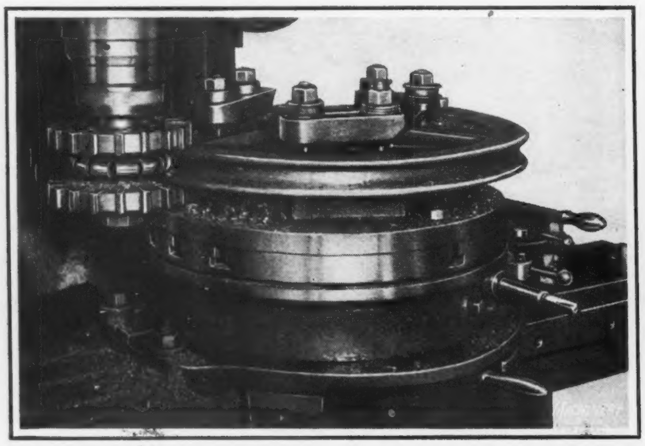


Fig. 7. First of Three Set-ups for machining a Crane Sheave

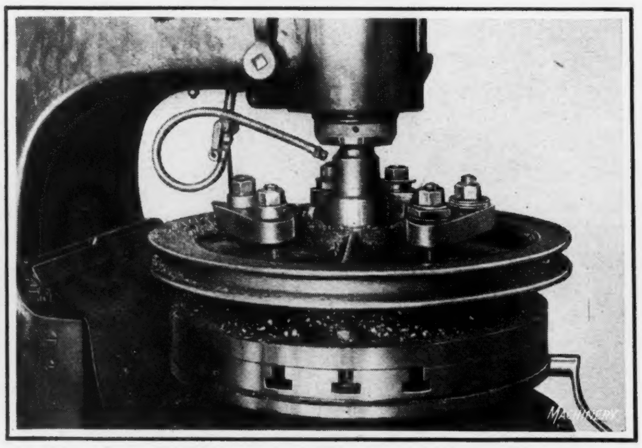


Fig. 8. Boring the Hole in the Hub of a Crane Sheave

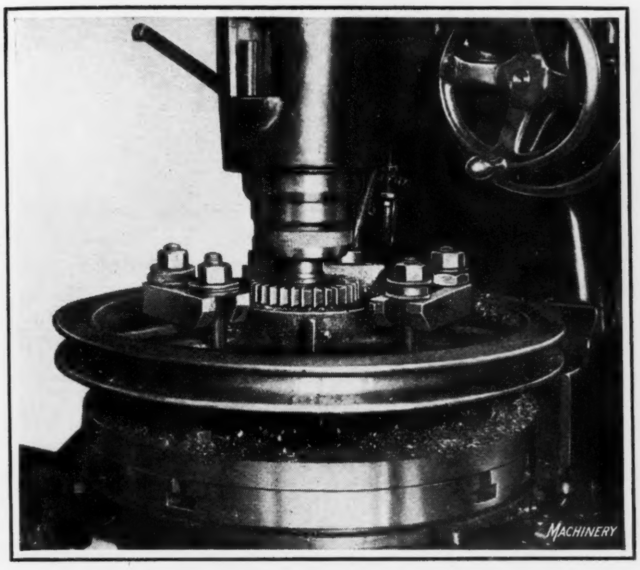


Fig. 9. Straddle-milling the Face of the Hub of a Crane Sheave

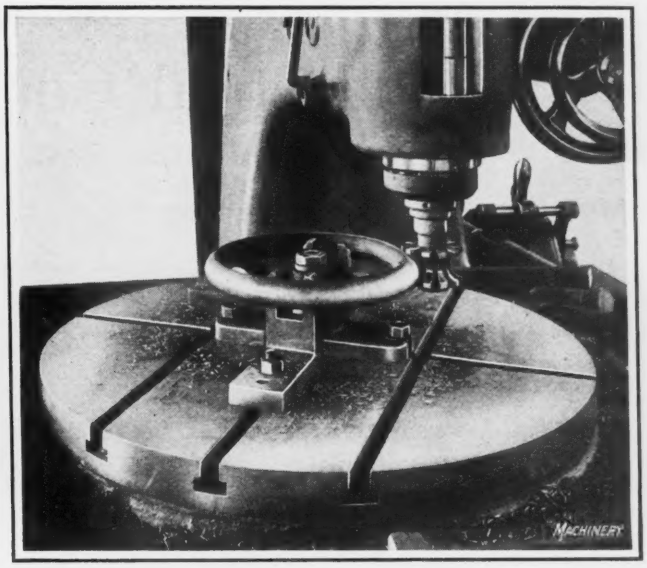


Fig. 10. Set-up for machining Rim of Milling Machine Handwheels

Machining the Rim of Milling Machine Handwheels

Handwheels used on Becker machines are first bored and faced on Gisholt turret lathes, and then finished on the rim by rotary milling and polishing. Fig. 10 shows the set-up used in the milling operation. After being received from the turret lathes, the handwheels are located for machining from the previously bored hole and faced hub, using a central stud and clamping nut to secure them in place. Two driving arms in the form of angle-plates are used, these being machined to straddle opposite arms of the casting. The central locating stud for the handwheel is carried in a base casting which can be quickly and conveniently attached to the machine table as shown. A special high-speed concave milling cutter, operating at a speed of 45 revolutions per minute, is used. The table feed is 7 inches per minute, and from 1/8 to 3/16 inch of metal is removed. The wheel is 10 inches in diameter, and it required approximately four and one-half minutes to complete the work.

After the milling operation, the milled rim is finished by holding it loosely on an arbor, against the workman's leather apron, and spinning it against a felt buffing wheel. This buffing wheel is faced with 60-grain alundum, which is glued to the felt. A final polishing operation is performed with a formed-face felt wheel, using 120-grain alundum.

PLANING STOCK REEL SUPPORTS FOR AUTOMATIC SCREW MACHINES

Figs. 1 and 2 show a 24- by 30-inch planer, built by the Putnam Machine Co., Fitchburg, Mass., engaged in planing the base pads for a stock reel support for an automatic screw machine. This planer is used by the National Acme Co. in its plant at Cleveland, Ohio. The planing operation is quite simple, but the fixture which is employed for supporting the casting during the performance of the operation is somewhat unusual.

The fixture consists of a heavy 90-degree angle-block, strapped down to the table, with provision for carrying the end thrust of the tools. On the casting that is to be planed, there are two lugs *A* that project over the top edge of the fixture and rest on hardened steel supporting pads. The casting is then clamped in this position by tightening a strap *B*.

It will be evident that additional support must be provided to hold this large piece of work back in position against the vertical face of the fixture, and this is furnished by a bolt *C* by means of which a long strap *D* is tightened to hold the work back against the fixture. It will be seen by referring to the illustrations that the planing operation is performed by a single-point tool *E*.

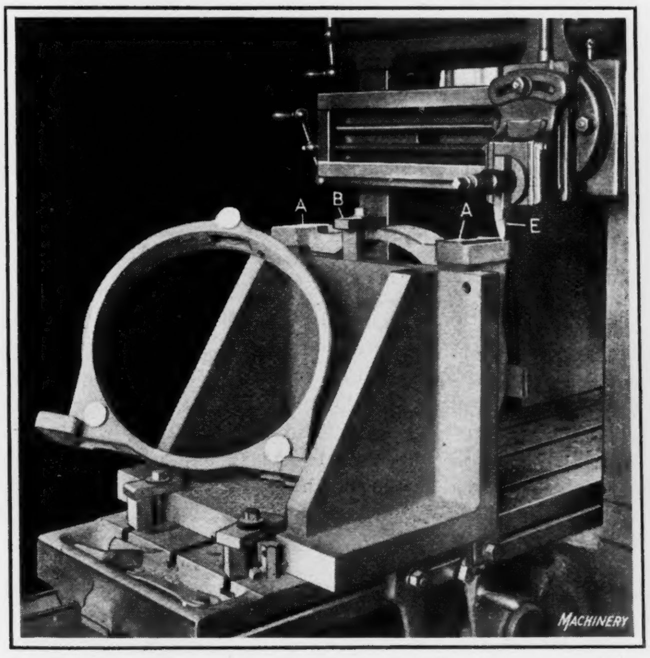


Fig. 1. Planing Base Pads on Stock Reel Support for an Automatic Screw Machine

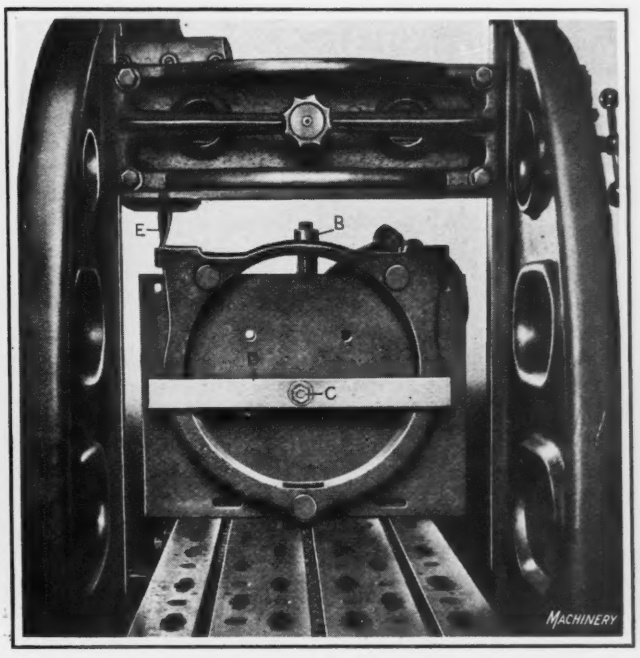


Fig. 2. Opposite Side of the Work and Fixture for planing Stock Reel Supports

Industrial Conditions in Spain

By RAMON CASALS, Manager, Fenwick & Co., Barcelona, Spain

THE metal-working industries of Spain are passing through a critical period. The industrial crisis which the entire world is experiencing is felt here more than in most other countries, due to the abnormal stimulus that the metal-working industries received during the war period, the activity of which cannot be sustained.

During the war and all through 1919 every concern of any importance received a great many orders from the allied nations, and many were also busy on work for the domestic market. During this entire period it was not essential to be a first-class manufacturer, far less to be a specialist, in order to obtain business. Hence, many shops and factories were established employing inferior equipment, material, and workmanship. Those shops that were developed with a view to meeting post-war competition in the world's markets are comparatively few. Hence, as soon as the boom was over, it was easy for Germany, France, and Italy to enter the Spanish market with the result that the imports during the second half of 1920 and the first four months of the present year were very large. This, together with the sudden reduction in prices, was the immediate cause of the crisis which the metal-working industry in Spain is now passing through. As an example of the abnormal conditions, it may be mentioned that some manufacturers, after having developed the design of special machines, have sent the drawings to German manufacturers to have the machines built for about one-half the price at which they could be built in Spain, inclusive of delivery charges. Besides, the Germans have been able to make quicker deliveries.

It is expected that this critical situation will gradually improve, partly because of the increase in import duties that is now in effect, and partly because the manufacturers are beginning to specialize and thereby reduce manufacturing costs. In addition, the industry is hopeful of the passage of an important railway construction bill, now under discussion in the Spanish Parliament. If this bill is passed, it will increase the activity in various metal-working branches.

The Machine Tool Trade

The building of machine tools in Spain, started during the war, has been almost entirely discontinued. During the war some copies were made of American machines. The classes of machines built were lathes, planers, shapers, and simple milling machines and drilling machines. Some of the builders of these machines now have a large stock, and those in particular who were ambitious enough to undertake the building of machines of highly developed designs have been obliged to retire from this business entirely. All firms dealing in machine tools have large stocks on hand, and there are at present very few inquiries. As a matter of fact, scarcely anybody buys anything at the present moment; any orders that may be placed are almost entirely for repair shops, and these small shops want inexpensive machines. They, therefore, rather prefer offers from German makers who quote from 50 to 60 per cent less than the price for American machine tools in Spain, although it is well known and recognized that these inexpensive machines are of rather inferior quality.

American machine tools continue to be highly appreciated in Spain, and more so after some sad experiences which some buyers have had with German machine tools. They believed that they had gained certain advantages in buying some machinery from Germany, but were afterward obliged to return the machines as unsatisfactory, suffering considerable losses. Nevertheless, in spite of experiences like this, there are still firms who prefer to buy inexpensive machinery, but this would not be the case if the difference in price were not as great as it is at present, due partly to the high rate of exchange of the dollar and partly to the actual difference in price.

It is difficult to forecast the future, but there are reasons to believe that manufacturers of standard types of machine tools may expect a fair export trade to Spain when conditions become more stable. It must be borne in mind that there are more than 1500 firms in Spain using machine tools, and 97 per cent of these are so badly equipped that if they do not provide themselves with better machinery, 80 per cent of them will have to close down altogether, because of inability to compete with foreign manufacturers. There are also new industries gradually being developed in Spain. The automobile industry has been rather quiet lately, but it is expected that the increased import duties on automobiles will aid this industry, and that it will show a healthy growth as soon as the commercial and industrial situation becomes more normal.

Spanish Import Duties

In the early summer, a considerable increase in the import duties went into effect. The increase was especially large for machinery of all kinds. A month after the general tariff bill had gone into effect, a further increase in import duties was made affecting machinery imported into Spain from countries with an unfavorable rate of exchange —Germany, France, and Italy. The duties on different classes of machine tools in accordance with these new import duties are given in the following list. On account of the fluctuation in exchange, they are given in pesetas (exchange on October 20, 1 peseta = 13 cents).

Machine tools and parts for machine tools weighing over 501 kilograms (1100 pounds) are assessed at 40 gold pesetas per 100 kilograms gross weight. A gold peseta, of course, is worth the regular normal value (one gold peseta = 19.3 cents) so that when paid in paper pesetas at a lower rate of exchange, the import duty is about 40 per cent higher. For machinery imported from countries with an adverse rate of exchange, as far as Spain is concerned, the import duty is still higher. For instance, if a machine, boxed, weighs 2000 kilograms (4400 pounds) it would pay the following duty:

From the United States	1124.72 pesetas
From France	1416.60 pesetas
From Italy	1597.10 pesetas
From Germany	1814.95 pesetas

In this case the value of the peseta is figured at present exchange, that is 1 peseta = 13 cents.

Machine tools and parts of machine tools weighing less than 500 kilograms (1100 pounds) pay 50 gold pesetas per 100 kilograms gross weight. The custom duties in this case also are increased according to the exchange rate with the country from which the machine is imported, so that a machine weighing 400 kilograms (880 pounds) would pay duty as follows:

From the United States	285.20 pesetas
From France	389.20 pesetas
From Italy	405.00 pesetas
From Germany	560.20 pesetas

The pesetas in this table are figured at present exchange (1 peseta = 13 cents).

Forging hammers pay duty at the rate of 44 gold pesetas per 100 kilograms (220 pounds) plus the addition due to the foreign exchange rate. A forging hammer weighing 5000 kilograms (11,000 pounds) would therefore pay duty at the following rates:

From the United States	3087.50 pesetas
From France	4088.70 pesetas
From Italy	4388.25 pesetas
From Germany	4981.80 pesetas

The foregoing is figured at present exchange (1 peseta = 13 cents).

Small tools pay duty at the rate of 40 gold pesetas per 100 kilograms (220 pounds). Electric motors and other electrical machinery pay very high rates of import duty, as follows:

Up to 100 kilograms (220 pounds)	150 gold pesetas
From 100 to 400 kilograms (220 to 880 pounds)	142 gold pesetas (per 100 kilograms)
Above 400 kilograms (880 pounds)	75 gold pesetas (per 100 kilograms)

When paid in paper pesetas, the rate is 40 per cent higher, and in addition higher rates of duty are paid when the imports are from France, Italy, or Germany or other countries having a low exchange rate.

Important Industrial Plants in Northern Spain

In the metal-working industry, northern Spain presents the most promising field. A number of large companies are located here, of which a few may be mentioned. In Bilbao, we find the Altos Hornos de Vizcaya, an important company owning two factories specializing in the iron and steel field, operating extensive rolling mills for rails and plates, and employing from 4000 to 6000 men; a shipbuilding concern, the Compania Euskalduna, capable of building and repairing ships up to 12,000 tons, and employing from 3500 to 4500 men; and the Vasconia Compania Anonima, which builds aerial tramways and bridges and specializes in many other structural lines, employing from 2500 to 3500 men.

The Sociedad Espanola de Construcciones Babcock & Wilcox in Galindo, province of Vizcaya, has recently been established in Spain for the manufacture of locomotives, both for the Spanish national railways and for export. The shops just erected are very large and imposing, and in addition to the manufacture of locomotives, the company constructs boilers of its own design, manufactures seamless steel tubes, and builds cranes.

An important company devoting itself to the building of ships has three large factories and shipyards located in Sestao (province of Vizcaya), Ferrol, and Cartagena. This company, Sociedad Espanola de Construccion Naval, is partly owned by Spanish capitalists and partly by the well-known firm of Wickers in England. An important factory for general machine shop work, castings, etc., is located in Mondragon, province of Guipuzcoa; this company, La Union Cerrajera, employs over 2000 men. The Compania Auxiliar de Ferrocarriles, Beasain, province of Guipuzcoa, is devoted to the building of railway cars, and is equipped to turn out 2500 cars annually. Besides these factories in northern Spain, there are many others of similar size and importance.

* * *

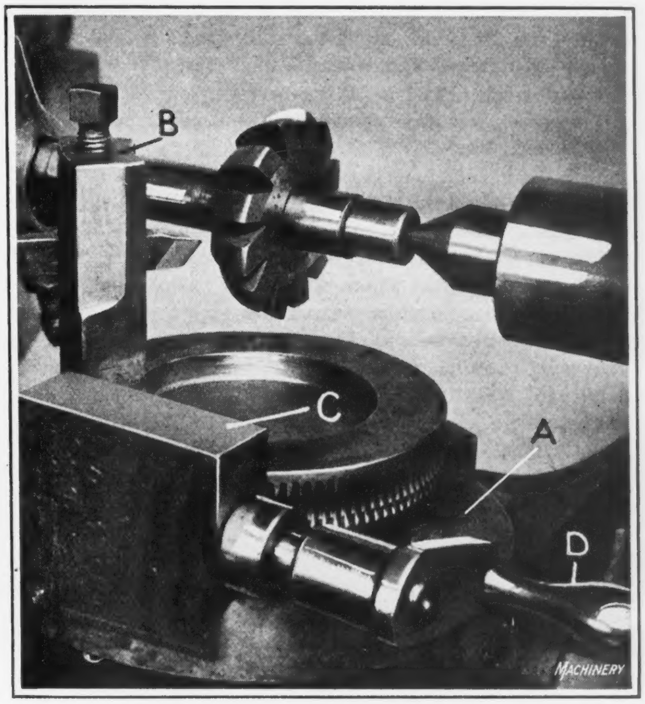
COST OF CHANGING TO THE METRIC SYSTEM

In order to determine the probable cost to manufacturing concerns of the compulsory introduction of the metric system, the American Institute of Weights and Measures, 115 Broadway, New York City, requested a number of manufacturers to study this question and prepare estimates of the cost of changing over to the metric system in each plant. Thirty-one firms located in a number of different states submitted estimates showing that the total cost for changing over in these thirty-one instances would be about $21,500,000. The plants referred to employ about 95,000 men, so that the change would cost over $225 per worker.

RADIUS TURNING FIXTURE FOR TOOL-ROOM

By O. S. MARSHALL

The demand for formed milling cutters and forming tools such as are used on automatic machines, makes it desirable that tool-rooms be provided with some kind of radius-generating device which may be used on an engine lathe for forming the circular part of forming tools. The accompanying illustration shows a simple arrangement designed for this purpose, which can be mounted on the lathe cross-slide in place of the usual compound rest. The base *A* is bolted to the cross-slide, using the bolts employed in securing the compound rest. The toolpost *B* has on the under surface of its base, a hub which extends through the lower baseplate. A nut and collar on the end of the projecting hub serve to hold the toolpost member to the base and provide adjustment for wear. A worm-gear is cut on the base



Radius-turning Lathe Fixture

of the toolpost which is hand-operated by a worm concealed by guard *C*. Handle *D* is used to rotate the toolpost.

The toolpost member was made from a solid block of steel, the center being bored out and the surplus stock sawed away, leaving a narrow column, as shown, to carry the turning tool. The column is cut down to permit turning through as large an arc as possible when the blank is held on an arbor. This particular fixture will generate inside or outside circular forms such as required on the usual line of forming tools employed in ordinary shop work. The distance from the center of the hub on which the toolpost turns, to the tool point when the tool is drawn back the maximum amount is 2½ inches. For large internal forms the tool may be used with the point extending away from the post. A high degree of accuracy is attainable, and a fine finish is produced on high-speed steel tools.

* * *

Direct government control of the railroads in Great Britain, which has existed for the last seven years, ended in August. The financial results of the operations show that while the income has been doubled during these seven years, the expenditures have been tripled. With the releasing of the control of the railroads from government administration, they will also be deprived of the government support by which the deficit between income and expenditures has been equalized.

How Factory Investigations Reduce Costs

By ALBERT A. DOWD, President, and FRANK W. CURTIS, Chief Engineer, Dowd Engineering Co., New York City

How To Reduce Production Costs ?

THE factory investigator who produces results is not content with a surface analysis of conditions; he starts at the bottom of things and determines how various parts should be manufactured, estimating the length of time which would be required under first-class manufacturing conditions. After this he looks up the cost records and compares the actual cost with his estimate. If he finds that there is only a small amount of variation in certain parts, he is satisfied that in these instances the loss in production is not heavy. Occasionally a difference of 50 per cent or so may be found between his estimate and the actual cost of production; naturally such conditions will require investigation to find out the reason why the costs are higher than they should be.

Effect of Design Upon Cost of Machining

While the engineer is looking through the blueprints of various components of the mechanism which is being manufactured, he considers carefully the design of the parts with respect to their effect upon the cost of machining. Many designers do not consider as carefully as they should the various processes necessary to machine the product, and as a result the tool engineer is frequently forced to design complicated tools in order to machine a certain part, when a few changes in design would make the operations much simpler. The factory investigator looks into these points, at the same time realizing that there is a disinclination on the part of factory executives to permit changes in design unless it can be conclusively shown that specific savings will result. Therefore, before any suggestions of this kind are made, it is always necessary to consider the amount of material which has been purchased for the parts to be machined, especially if the contemplated changes in design make it necessary to use castings, forgings, or bar stock of different sizes from those which may have been ordered for the work. The suggestion may, however, be offered for use in the future, after a certain amount of ordered material has been used.

Under present conditions when a factory is only running part time, there is an excellent opportunity for the manufacturer to call in an expert investigator and seriously consider any suggested changes in design, as these may be the means of saving a great deal of money when he is again ready for production. By preparatory work of this kind and by a careful analysis of design, tools and methods, the manufacturer may be able to reap a future reward in proportion to the pains taken. No manufacturer can afford to neglect the present opportunity to look carefully into his methods of manufacture.

Examples of Savings Realized by a Change in Design

A number of examples can be cited to illustrate the advantages of a design in which manufacturing methods have been carefully considered. Fig. 3 shows an example which illustrates the points mentioned. At the same time the change in design suggested gives a better product and one

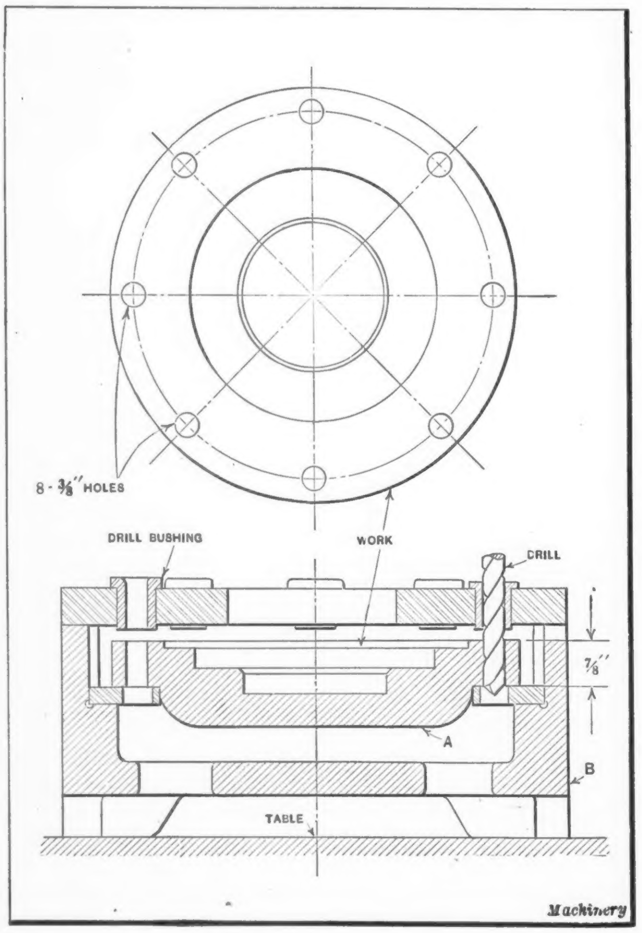


Fig. 1. Jig originally used for drilling Cast-iron Cover

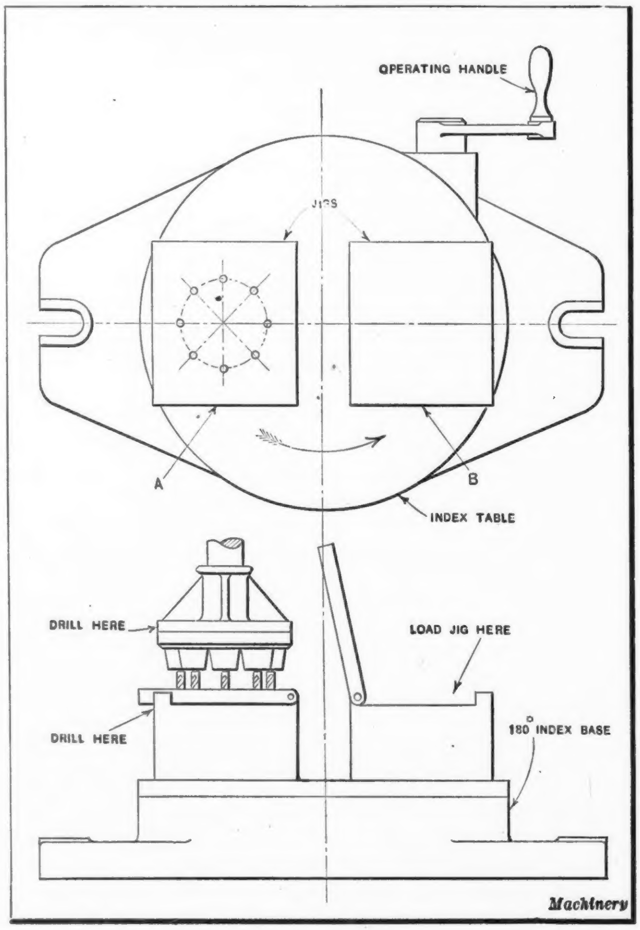


Fig. 2. Use of Standard Index Base for drilling Cast-iron Cover

in which there is less likely to be trouble. The work shown at *A* is a double gear made up of two separate parts *B* and *C*, which are riveted together as indicated. The engineer's attention was drawn to this part on account of the possibility of looseness developing between the two gears after they had been in use for some time. An inquiry developed the fact that trouble occasionally resulted from this cause, but that it had not been serious enough to require any change in the method of manufacture. However, as it would generally be considered better practice to use a single piece in preference to two or more parts riveted together, the investigating engineer suggested making this part as shown at *D* from a solid piece of steel. An analysis of the two methods is given in the following table, and the savings effected can be readily seen.

OLD METHOD

Operation	Time, in Minutes
Operation 1—Blank out both gears complete on automatic screw machine—two machines, one man	2.80
Operation 2—Cut teeth in both gears (twelve pieces per arbor)—two machines, one man	1.10
Operation 3—Drill six rivet holes and countersink both parts	2.60
Operation 4—Assemble rivets and rivet two parts together on riveting fixture—one machine, one man	1.30
Total	7.80

NEW METHOD

Operation	Time, in Minutes
Operation 1—Blank out gear complete on automatic screw machine—two machines, one man	2.50
Operation 2—Cut teeth in large gear on gear-hobber; (two pieces per arbor)—two machines, one man	1.09
Operation 3—Cut teeth in small gear on gear shaper—three machines, one man	1.90
Total	5.49

A comparison of the two methods shows a saving in time effected by the second method of 2.31 minutes. The actual increase in production is approximately 40 per cent, and in addition the new part is much better than the old, as it is a solid piece with no possibility of any change of relation between the positions of the two gears. While there is little clearance between the two gears, the small one can be cut readily on a Fellows gear shaper.

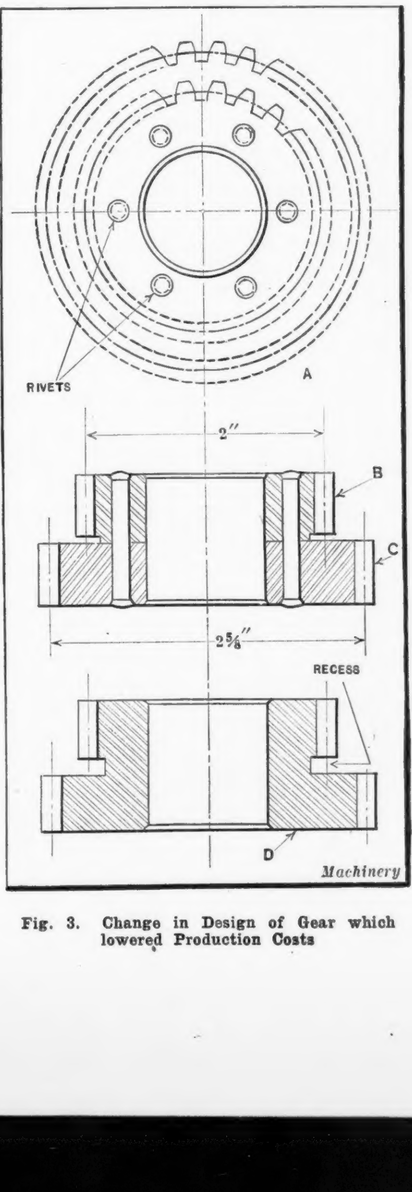


Fig. 3. Change in Design of Gear which lowered Production Costs

On large castings which are designed with brackets applied on angular surfaces, the investigator can often effect large savings by doing away as far as possible with the angular surfaces and making them straight. By so doing awkward and expensive fixtures can be avoided and simple designs used. This point is also of value in connection with the assembling of the completed mechanism, as much less difficulty is experienced in aligning the various members. A good example of this sort is an automobile crankcase having one or more angular pads to which brackets are applied. In machining an angular surface on a large casting, it would be necessary to design a massive fixture on which the work would be set up at an angle, in order to bring the surfaces in the right relation to the milling cutter. The suggested changes in design obviate all this trouble and allow the tool designer to make a simple and inexpensive fixture. Many other cases can be cited to show advantages obtained by improvements in design which assist in making the machining processes easier.

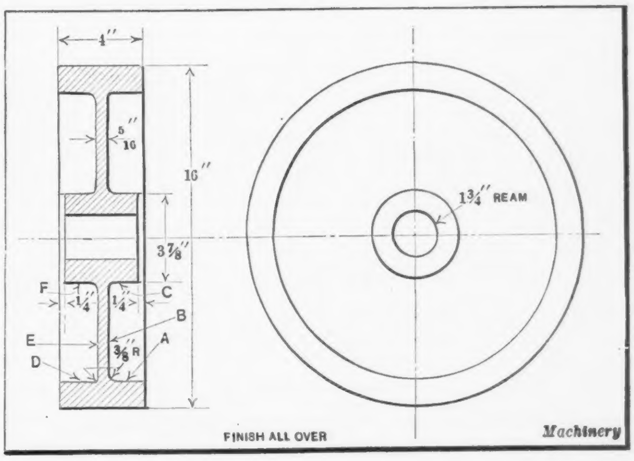


Fig. 4. Flywheel Pulley produced at Lower Cost by Improved Methods

Use of Standardized Equipment

Frequently the equipment of a factory may not be up to date and much time is lost in machining various kinds of work without modern appliances. A number of devices are on the market which are time-savers and which can be installed at a nominal cost. The savings effected will usually pay for such appliances in a short time. The investigating engineer often sees opportunities for using devices which are standardized and may apply them to various operations in the shop with gratifying results. Quick-operating vises, quick-change chucks, quick-acting dogs, index bases and self-centering steadyrests are among the appliances which will be found of great use in saving time and production. Quick-operating vises may be fitted with special jaws to take the place of a milling fixture. Quick-change chucks assist greatly in production by making it possible to change drill sizes rapidly while the machine is still running. Quick-acting dogs save time because they adjust themselves automatically to an arbor on which work is being turned. Self-centering steadyrests are also automatic in their action and save time by the ease with which they adjust themselves to the work. An index base can be applied to many operations in the shop and saves time by allowing two or more fixtures or jigs to be placed on it, so that one can be loaded while the other is in position for machining.

Savings Effected in Drilling

An example which shows the application of a standard index base to a production job and the savings effected thereby is illustrated in Figs. 1 and 2. Fig. 1 shows the work *A* which is being machined in large quantities in a drill jig *B*. There are eight ⅜-inch holes in the work, spaced evenly around the flange, and these are drilled by means of a multiple drill head. In order to increase production, the suggestion is made by the investigating engineer that a standard type of index base be purchased, such as shown in Fig. 2. On the table of this mechanism two jigs are fastened at *A* and *B*, in such a position that while the holes are being drilled in *A* jig *B* can be loaded, so that there is very little lost time.

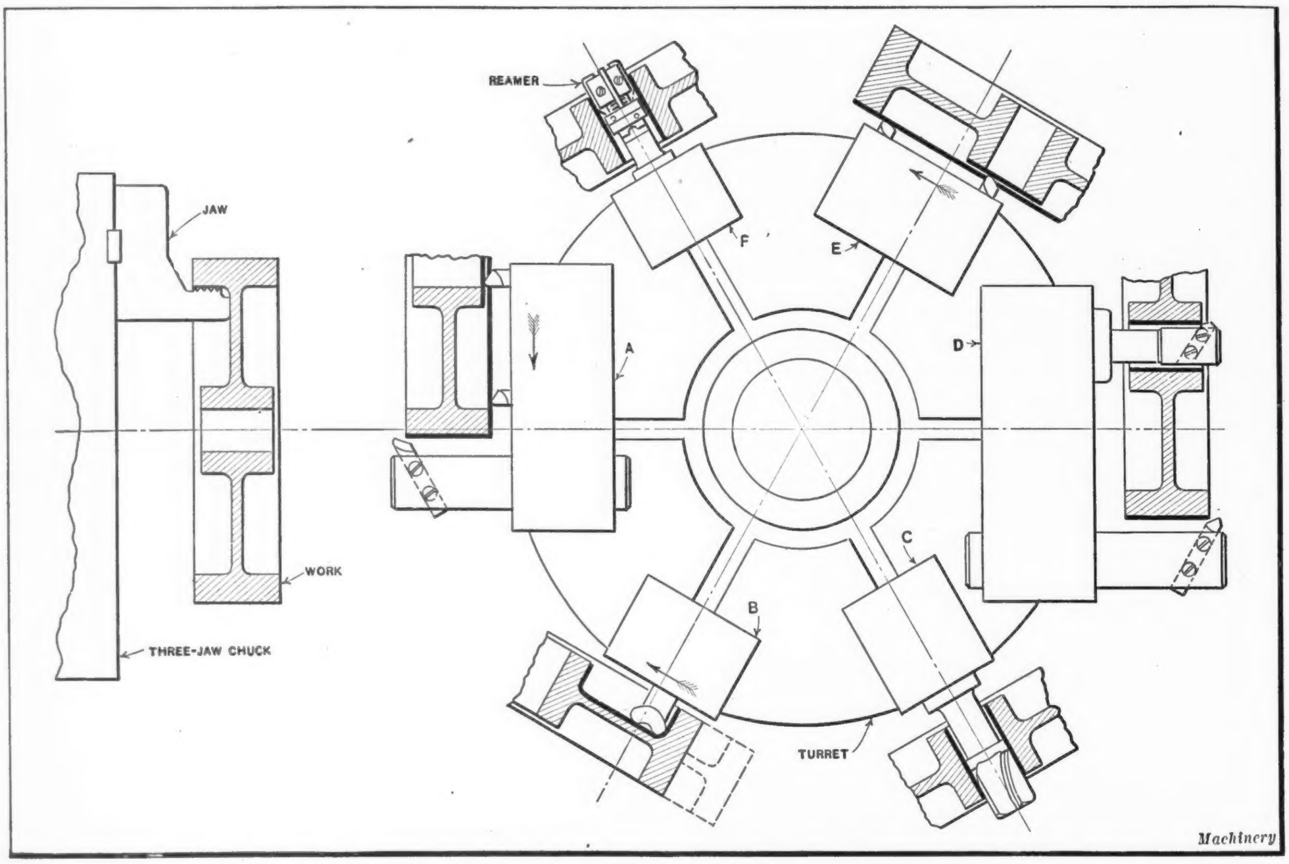


Fig. 5. Standard Tooling Lay-out for Work shown in Fig. 4

A comparison of the two methods is interesting. When using a single jig the work is produced in seventy seconds, or 411 pieces per eight hours. By the new method, using two jigs and an index base as shown in Fig. 2, the work is produced in forty seconds, giving a production of 720 pieces per eight-hour day. The production by this method is increased approximately 75 per cent. The index base and an extra jig represent an investment of approximately $350. The gain in production is such that this outlay is absorbed in about forty-eight days.

Manufacturing a Flywheel Pulley

Turret lathe makers furnish a variety of standard tools which are designed so that they can be adapted to various conditions. They are extremely useful for short jobs, and even for certain kinds of high-production work. There are cases, however, when special tool equipment may be found more productive, as it is designed for the particular case in question. Fig. 4 shows a flywheel pulley, 16 inches diameter by 4 inches face, which was finished all over by using standard tool equipment, as indicated in the turret lathe lay-out shown in Fig. 5. The portions *A*, *B*, *C*, *D*, *E*, and *F*, Fig. 4, require rough-machining only, no accuracy being necessary at these points. The work is held by means of the inside chuck jaws as shown in the lay-out. In the first chucking, the outside is turned, and the hub and one side of the flange are faced by means of the standard tool equipment shown at *A*. The turret used is of the cross-sliding type, which allows the tools to be fed as needed for the facing cut. The inside of the flange, the web, and the hub are machined by a double-lip tool in a holder shown at *B*. No further machining is required on this portion, as the roughing cut is all that is necessary. After this operation is completed, a core-drill is used for drilling out the hole in the hub of the pulley as shown in the diagram at *C*. The core-drill is followed by a boring-bar, in combination with a finish-turning tool for the outside diameter. This set-up is shown at *D*. The next operation, shown at *E*, consists of finish-facing the end of the hub and the flange. The final operation is the reaming of the

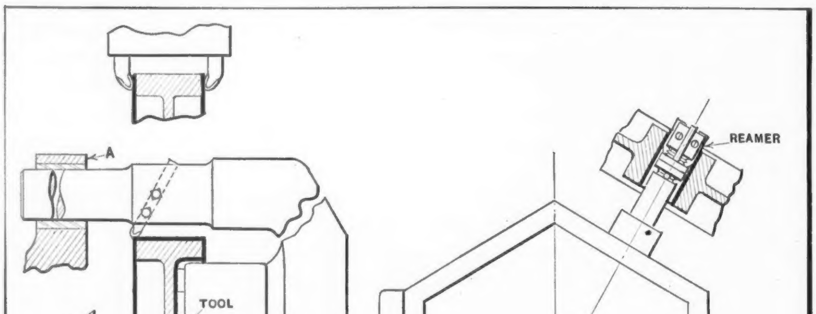


Fig. 6. Special Tooling Lay-out for Work shown in Fig. 4

hole in the hub, which is done by a reamer in a floating holder shown at *F*.

In the second chucking, the work is held by the outside in soft jaws, and some of the same tools are used for turning the inside, and facing the hub and web. The tools not used in the second chucking are the outside turning tools, core-drill, boring-bar, and reamer.

Due to the method of machining, it was found that the hole did not run perfectly true with the outside diameter, and for this reason a lathe operation was found necessary. The work was held on an arbor and a light cut taken over the outside diameter and the two flanges, in order to square them up true with the hole. The total time necessary for machining the flywheel pulley complete in the three chuckings employed with this method was seventy-seven minutes.

The investigator decided, after an inspection of this job, that the work was being turned out much too slowly, and he therefore suggested a revision of the tooling, after finding out that the work was a standard product on which any savings would be much appreciated. The suggested changes in tooling are shown in Fig. 6. In the first chucking, the work is held by the inside of the flange in special jaws in a three-jaw geared scroll chuck, the jaws being cut away so as to permit the facing tools to operate without interference. Two special combination tools were made for turning, facing, and boring, the turning tool being supported in a pilot bracket on the headstock of the machine, as shown at *A*. This means of support allowed heavier cuts to be taken without vibration. In connection with the turning tool, a cutter-head was used with several cutters in it so arranged that they would bore the inside of the flange, face the web and turn the hub at the same time. These tools were staggered so as to break up the chip and make the cutting action easier. A boring-bar was also piloted in a bushing in the chuck, and a face mill used to face the end of the hub. While these operations were in process both sides of the flange were faced by two tools in the cross-slide front tool-block *B*. The cuts mentioned are all roughing cuts, but the finishing operations were performed by similar tools shown at *C*. These consisted of a turning tool in combination with a boring-bar and face mill. While this finishing operation was in process two tools in a special tool-block on the rear of the cross-slide were used to finish-face the sides of the flange. The final operation is the reaming of the hole in the hub. As the boring tools used are of the single-point type, the hole and the outside diameter must necessarily be concentric.

In the second chucking, the work is located on a plug in the center hole, the plug being held in a faceplate and the work clamped by means of straps on the face of the flange. The tools used for this second chucking include only the facing tools used in the first chucking. The turning tools and boring-bars are removed. The reamer also is not used in the second chucking. The total time necessary for both settings by the new method is twenty-four minutes.

A comparison between the old and new methods shows an increase in production of over 230 per cent, as the number of pieces produced by the old method was six per day, while the new method gave twenty per day. The old tool equipment included practically all standard tools, but the new equipment cost $460. The increase in production and decrease in cost of the second method over the first was so great that the new tool cost was absorbed in less than one month from the time when it was put in operation. Savings of this kind are remarkable and considerably more than is generally accomplished. The example given, however, is an actual case, which illustrates conclusively the possibilities of savings which can be effected by a careful investigation of modern practice and up-to-date equipment.

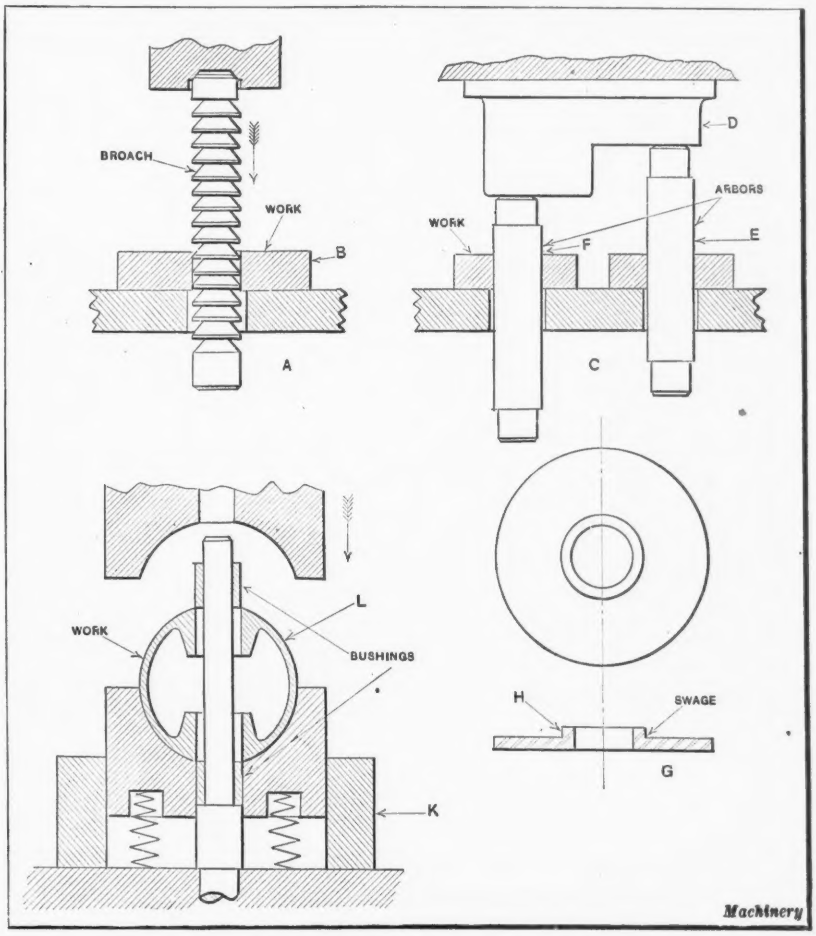


Fig. 7. Various Uses of Punch Press on Production Work

Savings Effected by the Use of the Punch Press

The average manufacturer does not realize the savings possible by using a punch press for various production operations. Shops which do not use sheet-metal work in their product to any extent are not likely to be equipped with punch presses, yet this type of machine is extremely useful for many operations in production work, and as it is comparatively inexpensive such an installation will be found profitable. The factory investigator is often able to suggest applications of a punch press to certain kinds of work not ordinarily done on these machines. For example, a punch press is useful in riveting together two or more parts which are assembled, although it must be remembered that it will not take the place of a riveting machine for all classes of work. However by using a simple fixture several rivets can be headed with one blow of the press, and the results obtained will be found very satisfactory. A little ingenuity on work of this sort will reveal opportunities for economical and productive tools.

Oil-grooves, straight or spiral, can easily be cut either outside or inside of a piece of work by using a punch press and a special fixture. The operation is rapid and the fixture can be of very simple form. Steel or brass work can be centered by means of a punch press instead of using a center-drill. The operation is considerably more rapid, and for certain classes of work fully as satisfactory. For certain kinds of slotting operations, a punch press is very useful and only requires the design of a simple fixture to make it profitable. It can frequently be employed for assembling operations in cases where bushings or pins are required to have press fits.

Fig. 7 illustrates several operations which can be performed on a punch press with a considerable saving over other methods. In the example shown at *A*, the work *B* is to be broached or burnished, and the hole brought to size. A simple broach can be applied to the punch press as shown, and the work accurately sized with very little trouble. The cost of a broach or burnishing tool is naturally dependent upon the shape of the work to be broached, but for sizing operations of irregular or round holes there is often considerable economy in using a method of this kind.

The usual method of placing work on an arbor is by means of an arbor press. This method, however, is rather slow, and a decided improvement on it is shown at *C*, in which a punch press is used for the purpose. The ram is provided with a block, as shown at *D*, and two pieces are set up on the machine at the same time. The arbor *E* is being pressed into the work while that at *F* is being removed. A great saving in time is effected by a method like this.

Parts are occasionally found in production work which require a rather long operation if made on a screw machine. One of these parts is shown at *G*. If the hub *H* is very short, it is easy to swage this on a punch press, so that the piece can be turned out accurately and very rapidly from sheet stock instead of from the bar. When great accuracy is required, a shaving operation can be resorted to for operations which might ordinarily require a profile cut. Many manufacturers think that sharp corners cannot be produced on a punch press, yet it is not particularly difficult under certain conditions.

In the article "Economic Value of Factory Investigations," published in October MACHINERY, two methods of making a small spur gear were compared, and the method of using shaving dies for the finishing cut, thus producing accurate work, was described. This particular operation was mentioned because it really stands in a class by itself, yet it is frequently overlooked by manufacturers who continue to make small gears of certain kinds by the old method. The size of the gear naturally determines whether it can be produced in this way or not, yet slight modifications in design can sometimes be made which will permit the work to be manufactured on a punch press.

An application which illustrates the use of a punch press in connection with a fixture for pressing in bushings in an automobile piston is shown at *K*. The work *L* lies in a nest which is supported on coil springs as indicated. The bushings are placed as shown, and a blow of the press drives them into place very rapidly. There is usually a slight amount of distortion after the operation, but as the piston has not been completely finished at this time, the subsequent operations true it up accurately and bring it to size. Increased production of from 100 to 200 per cent can frequently be obtained by using a method of this sort.

The use of die-castings covers a recognized field, and the savings resulting from this method of producing work are great. The investigator determines whether such work is advisable or economical for any of the parts used in the factory in which he is operating. It is not economical to use die-castings for small lots, as the cost of the die is considerable. For many kinds of work, however, die-castings can be made so that they are complete and do not require further finishing, holes, slots and various surfaces being so carefully made that they are within very close limits of accuracy. The cost of dies on large production work is quickly absorbed by the savings effected.

The examples given in this article are taken from actual practice, and the savings effected are substantial. The fact that the investigator looks at the matter from a different viewpoint from the inside man who knows all the details of the factory, makes it possible for the former to perceive details overlooked by the other man who is too close to the work to see it clearly. There is no better time than the present for the manufacturer to consider his methods of manufacture, and there is probably no better way to obtain results than by a survey of the entire scheme of production.

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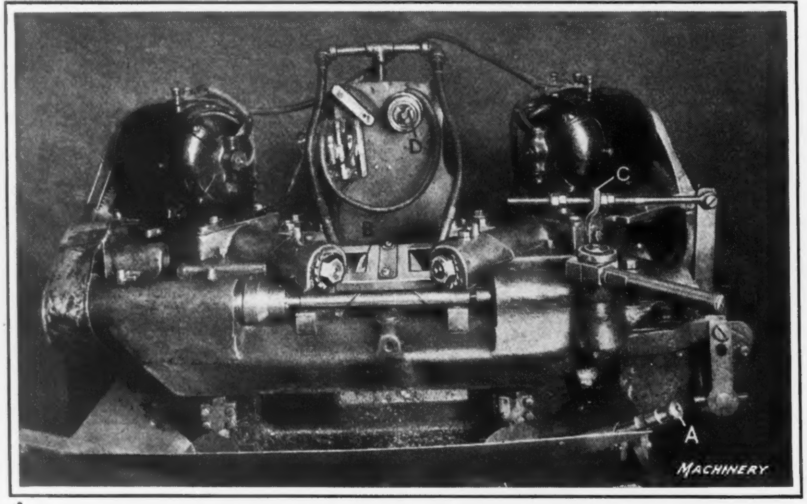
OIL-GROOVE MILLING MACHINE OF SPECIAL DESIGN

The accompanying illustration shows an oil-groove milling machine built and used by the De Laval Separator Co., Poughkeepsie, N. Y. This is a single-purpose machine designed to mill two helical oil-grooves which have opposite-hand leads, as indicated by the shaft shown held in the machine. The shaft is driven by a tongue in the chuck which fits into a machined slot *A* in the end of the spindle, the opposite end being supported by a regular lathe center. There are three motors used in operating this machine, one for driving each of the two cutter-arbors, and one for driving the combination right- and left-hand worm screw *B* and the chuck. The motors which drive the cutter-spindles are mounted on carriages, which move in opposite directions simultaneously, being actuated by the right- and left-hand worm screw.



Special-purpose Machine for milling Two Helical Oil-grooves simultaneously

After two grooves have been cut in a shaft, it is not necessary to return the carriages to the starting point, the work simply being removed and replaced. Then, during the cut on the next piece, the feed of the carriages is reversed so that they travel in opposite directions. By this means no time is lost in traversing the carriages when the cutters are not actually at work. The stop which limits the traverse of the carriage in either direction is shown at *C*, it being evident that the connections with the threaded rod operate the reverse motion of the carriages. The motor driving the right- and left-hand carriage feed-screw is hidden behind the board on which switch *D* is located.

* * *

INVESTIGATION OF MOLDING SAND

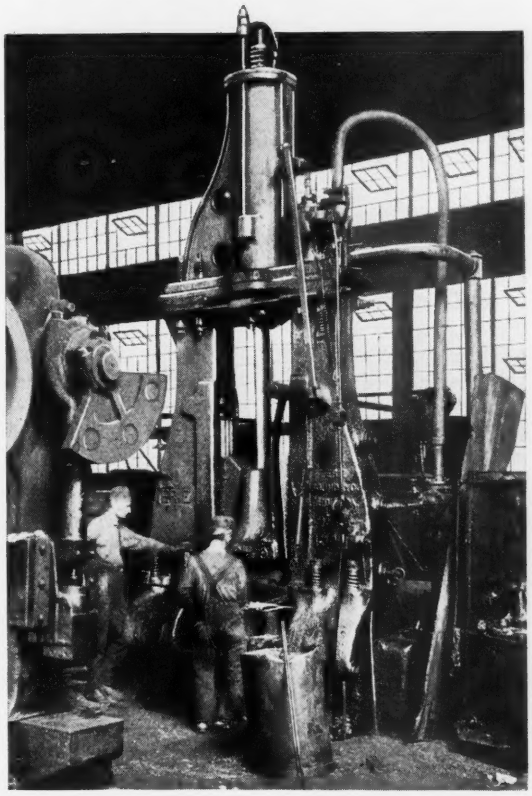
The molding sand investigation carried out by the American Foundrymen's Association in cooperation with the Engineering Division of the National Research Council is well under way. To avoid duplicating investigations already carried out, a summary of the existing literature on natural and artificial sands has been prepared. This summary covers the work of both the American and European countries. A questionnaire has also been sent to members of the American Foundrymen's Association to obtain a knowledge of work done along this line in American foundries. The information collected will be submitted to a committee of representatives from the various branches of the foundry industry and from the interested governmental bodies.

Modern Drop-forging Practice

Comparison of Drop-forgings and Castings, and General Methods of Making Drop-forgings
First of Two Articles

By FRED R. DANIELS

THE development in methods of producing drop-forgings has been due to the increasing demands upon this industry. In its infancy, the industry was confined to small forgings of comparatively plain design, and later, with the advent of the bicycle, to more complicated designs of a small size. With continued use, the inherent advantages of drop-forgings became generally recognized so that, in a great many lines, parts formerly made of malleable or steel castings were made from the stronger and tougher drop-forgings.



Comparison of Castings and Drop-forgings

It was soon recognized that added strength without increase in weight could be obtained by using drop-forgings in place of castings. Thus with the coming of the automobile, a vast field for development in the production of drop-forgings was opened. This also put the metallurgical world to a severe test in evolving special steels, as something better than the previously used steels was required. The development of many different kinds of alloy steels for forgings followed, as well as of steels for die-blocks. Finally came research work to determine the most satisfactory methods of heat-treating.

In comparison with drop-forgings, a casting has a rather coarse open grain, is brittle, and often contains blow-holes beneath its surface. The raw material from which drop-forgings are made, is stronger and tougher than a casting, and is still further improved by working under the drop-hammer. Where quantity is a factor, drop-forgings can often be produced more economically than castings. The advantages of drop-forgings have resulted in their replacing castings in many instances within the last few years. A few examples of parts that are now drop-forged instead of being cast, including mainly motor truck parts, are shown in Fig. 1. Among these are crankshafts, steering arms, axles and engine supports. The gears used in automobile construction are almost invariably machined from drop-forged blanks, and the satisfactory service rendered by gears made in this way has led to the use of drop-forgings for a great many other automobile parts.

The process of drop-forging has been developed to a point where thousands of pieces are practically completed under the drop-hammer and require little or no further machining operations. As a cost-reducing method, drop-forging ranks high among metal-working processes. In the drop-forging plant itself, costs may be reduced by applying certain principles and methods making for economy—by selecting steel of the right quality, and by keeping dies and stock in such a manner that they are readily accessible and the required die and the right size and kind of steel may be easily located. Drop-forgings, when used in quantity, can sometimes be made as cheaply as castings, and are superior in strength. Actual costs are then reduced by employing them, because of the improved quality obtained at an equal price. Furthermore, a saving is usually made in the cost of machining, due to the fact that a drop-forging generally requires less finishing than a casting.

The best material to use in making drop-forgings, from the standpoint of workability, is a 0.20 to 0.30 per cent carbon steel made by either the Bessemer or open-hearth process. Comparatively low carbon steels flow readily in the dies and fill up the impressions better than any of the higher carbon or alloy steels. Aside from instances where especially severe service is required, this grade of carbon steel is usually used, being properly heat-treated before being put into service. Greater difficulty is experienced in drop-forging high-carbon and alloy steels, and more caution must be employed in designing the dies so that there will be a minimum of sharp projections and deep impressions. Failure to fill the die impressions fully, which is likely to occur with certain grades of high-carbon and alloy steels, entails subsequent work and additional expense. Such forgings, at times, can be salvaged by building up the defect with the acetylene torch and restriking in the drop-hammer. This involves, besides the extra labor, the trouble of transporting the work to the welding department.

Among the many alloy steels which are commonly used for drop-forgings may be mentioned straight nickel, chrome-nickel and chrome-vanadium. Nickel steels must be carefully watched when being worked and treated. Chrome-nickel steel is probably the most difficult alloy to work under the hammer, and in addition to the special heat-treatment which this steel must receive, there are certain other precautions that must be taken. Steel forgings containing nickel should have large fillets, and should be worked fairly hot and not be permitted to cool rapidly by being thrown on a damp cold floor, or put out of doors where the cold air can quickly chill them. Large fillets reduce the possibility of cracks starting, and check the development of fatigue fractures in the work. Sudden cooling is injurious to the structure of those alloy steels in which nickel is an ingredient, and is also liable to cause distortion.

It is good practice to take a rough cut from forgings made from chrome-nickel steel before the final heat-treatment occurs. This will remove any

surface seams or laps, and will prevent the development of cracks which otherwise might be developed during the final heating. Generally, alloy steels are more sensitive and require far more care in working and in heating than straight carbon steels, and consequently the output is correspondingly reduced. A detailed account of the method of heat-treating drop-forgings of different analyses will be given in a subsequent article in this series.

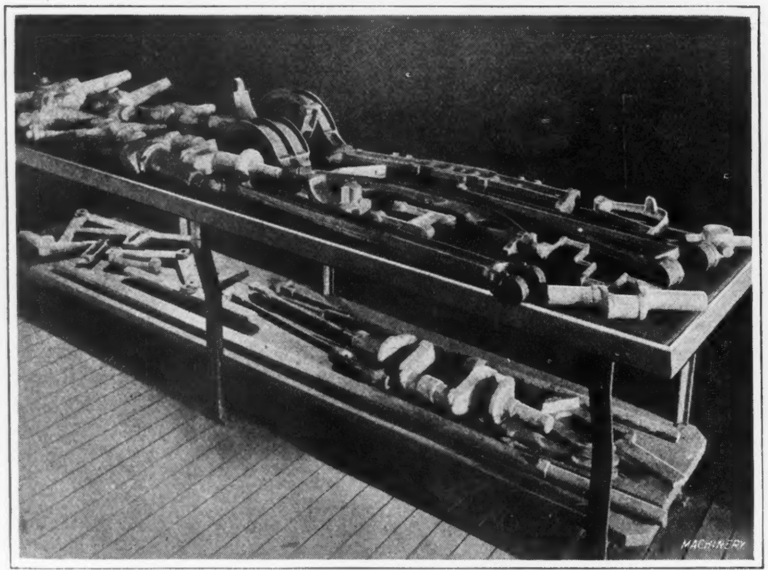


Fig. 1. Examples of Drop-forgings, showing Variety of Size and Design

Tungsten steel may be drop-forged, although a high forging heat is required. Of the non-ferrous materials, copper alloys, such as tobin, naval, and manganese bronze, can be readily forged, and aluminum can also be forged if it is handled with care, but the die impressions must be exceptionally well finished. No success has been met with in drop-forging phosphor-bronze or any composition of brass, although brass forgings can be produced by means of dies and applied pressure, which is a distinctly different process from drop-forging.

Selection of Drop-forging Steel

A great deal of care is usually taken in modern drop-forging plants in purchasing forging steel. The material is ordered from the steel mill in accordance with certain definite standards. Assurance that these have been maintained by the steel manufacturers is obtained by physical and chemical tests in the laboratories of the drop-forging plant, which test the material when received. Some concerns follow the practice of putting an inspector in the steel mill, and he sends a sample of the steel to the laboratory of the drop-forge plant to have its chemical analysis checked before the steel is shipped. After this sample has passed the exhaustive laboratory tests to which it is subjected, the process is repeated on a piece of steel cropped from the end of a bar as soon as the shipment arrives from the mill. When desirable, photomicrographs are made of these two pieces, so that a permanent record may be kept of the exact appearance of their structure. The filing cabinet shown in Fig. 2 is located in the laboratory of a large drop-forging concern and contains fractured test pieces, suitably marked. Record sheets, shown at the left of the cabinet, contain the data obtained by the various tests; and these furnish a permanent record of what each grade of steel is capable of withstanding in the way of tension, compression, impact, bending, wear, etc.

Suitable laboratory equipment for conducting these physical tests may consist of one transverse testing machine, one Brinell hardness testing machine, one impact testing ma-

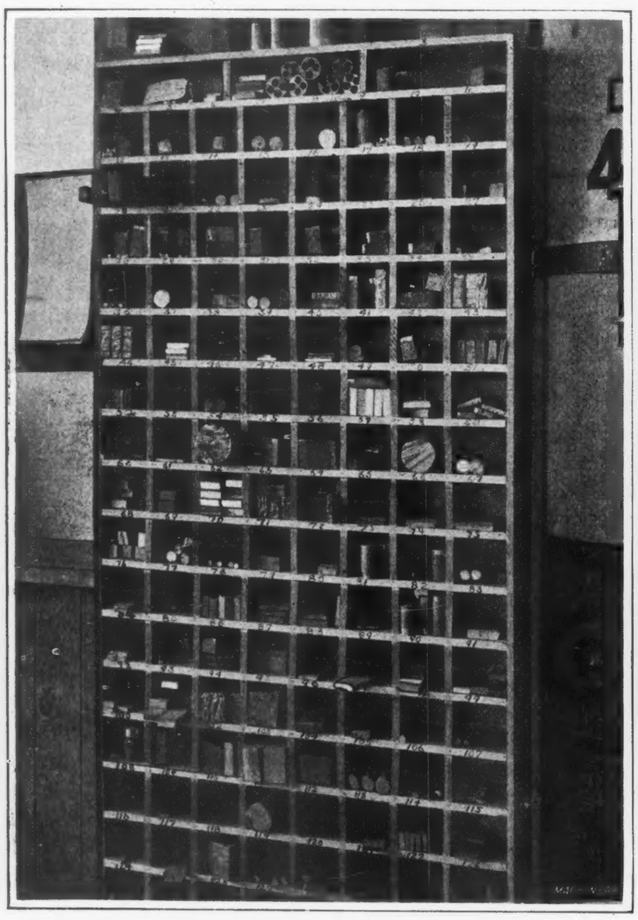


Fig. 2. Fractured Bar Steel Samples which have been tested in the Metallurgical Laboratory

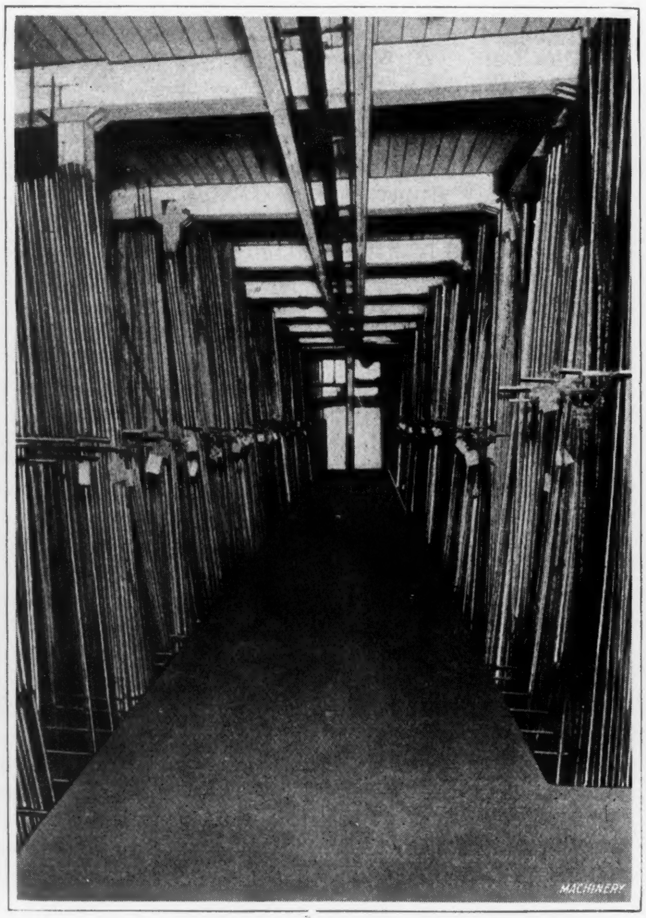


Fig. 3. Aisle in Storage House where Different Sizes of Bar Stock are stored

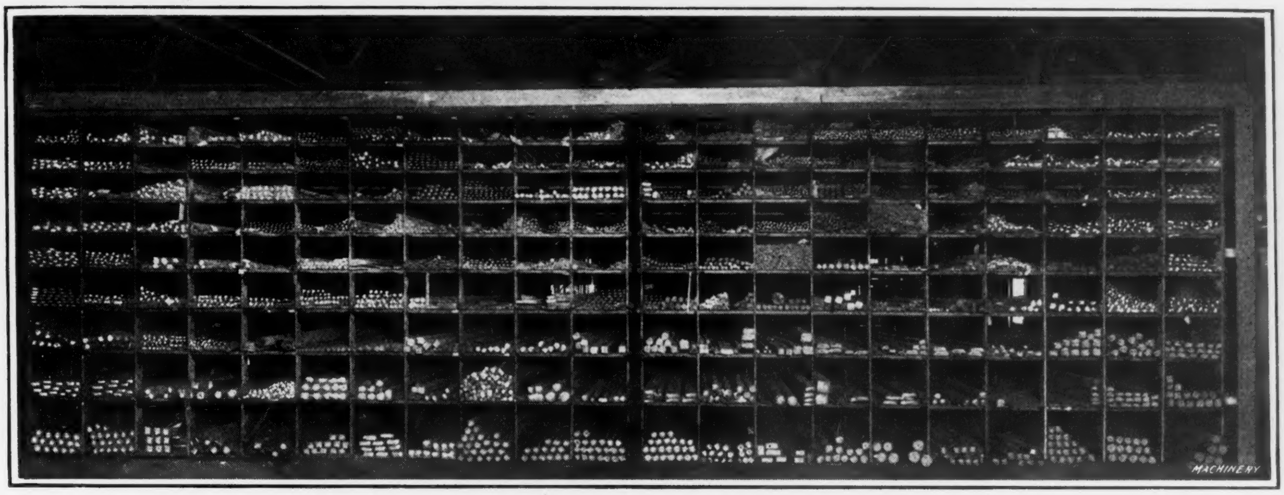


Fig. 4. Horizontal Storage Rack in which Special Grades of Drop-forging Steel are stored

chine, one tensile testing machine, and the necessary number and types of machine tools for cutting the metal into the sizes and shapes desired for test pieces. The apparatus used for making photomicrographs of the fractured test pieces shown in Fig. 2 is the product of the Bausch & Lomb Optical Co. of Rochester, N. Y., and is standard for this kind of work.

After the steel has been unloaded from the cars, it should be stored in suitable bins or racks and labeled, or marked by the color system. Figs. 3 and 4 show vertical and horizontal storage racks, respectively, which greatly facilitate the handling of stock, and which are in use in one modern drop-forging plant. Various sizes of bars have separate compartments, as shown in Fig. 3, while special grades where the quantities are small are placed horizontally, as in Fig. 4. The largest sizes are stored horizontally on floor stands.

Drop-hammers for Different Classes of Work

In the early development of the process, the size of drop-forgings and the material from which they were made, called for board drop-hammers of not more than 2000 pounds falling weight; in fact, at the present time where concerns are engaged in the manufacture of drop-forgings such as the smaller wrenches, eyebolts, chain ends and similar parts, hammers of this style and capacity are adequate. In the modern commercial drop-forge plant, however, there must be facilities for handling everything from small work up to heavy forgings of 350 to 400 pounds in weight, such as motor truck axles; consequently the range in hammer sizes must necessarily be such as will also conveniently handle this large class of work. The typical drop-forge plant, therefore, should be equipped with a much wider variety of apparatus than was formerly needed, but practice is so varied that standard requirements are very difficult to state. (See "Drop-forge Plant Lay-out and Equipment" in MACHINERY, July, 1921.)

In selecting the drop-hammer to use for producing a particular drop-forging, it does not necessarily follow that the size of the work regulates the size of hammer to use, although, of course, there is a certain relationship between the two. If the metal is hard to work, as for example chrome-nickel, it is always desirable to produce the forging with as few blows as possible; consequently the heavier drop-hammers will give the best results. If the forging is bulky, a hammer should be selected which will have enough falling weight to deliver blows that will penetrate to the center of the forging. As a general rule, it is better to select a drop-hammer which is too large for the job than one that is under weight. The greatest cross-section area of the forging must always be considered when selecting a hammer. The heavier drop-forgings are commonly produced on steam drop-hammers rather than on board hammers, and the inclination is, especially in the automobile industry, toward the use of steam drop-hammers, in a ratio of about two to one.

The depth of impression and the direction and distance the heated metal must be forced to flow in order to fill the die, the forging heat which must be used on the steel, and the intricacy of design, must each be given due consideration in the selection of the hammer. The sizes of hammers most suitable for different types of parts will best be learned by following the practice employed in the actual production of a number of drop-forgings to be described in the next article, which will appear in December MACHINERY.

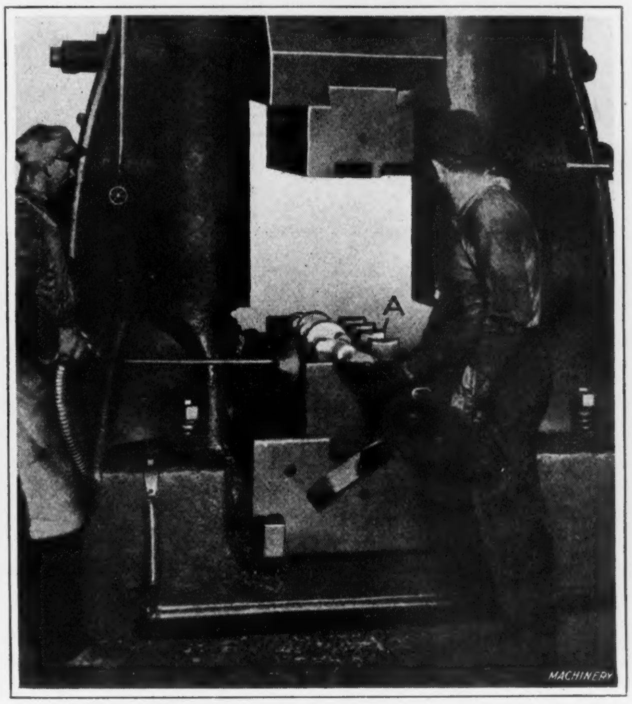


Fig. 5. Forging a Crankshaft

General Procedure

Starting with the smallest sizes of drop-forgings, the usual practice is to work from short bar lengths, rather than to cut the stock up into blanks, continuing this practice as long as it is practicable to do so. These bars are about 3 to 5 feet long, which is a convenient length for handling. They are placed in the furnace, and after being properly heated at one end, transferred to the dies and the forgings produced, this practice being continued until the bar is too short to be handled with tongs. The work is much easier to handle in this way than if individual blanks were used. On the very small sizes it is often possible to produce two drop-forgings with one heating of the bar, provided too many blows are

not required to produce each piece. In other words, by working from the bar, full advantage is taken of the heat retained in the bar after one drop-forging has been made, for of course, the bars are heated beyond the length required for the actual production of the drop-forging. The drop-hammers, which for small work are invariably of the board type, range in size from 300 pounds falling weight up to 2500 or 3000 pounds, which is the maximum efficient size for this type.

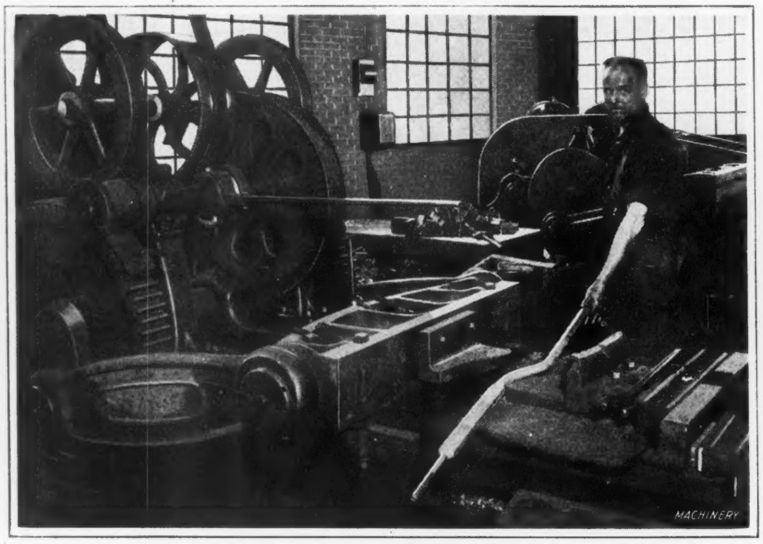


Fig. 6. Using Bulldozer for Preliminary Bending Operations on Large Work

Frequently the forger works with a helper who passes the heated bars to him and receives in return from the hammer man the end of the bar from which the forging has just been made, which he places back in the furnace fire. The hammer man usually works from left to right, first scraping the scale from the heated bar before fullering out his stock (the fuller being located conveniently on the side of the die as described in detail in the article "Design and Manufacture of Drop-forging Dies" published in August MACHINERY), and then transposing the drawn-out metal to the edger which is cut into the dies on the side opposite the fuller, and finally into the die impression. If two die impressions are required—a breakdown and a finishing impression—the breakdown is usually located next to the edger and the finisher between the breakdown and the fuller.

One blow is all that is usually needed to edge the drawn-out stock. For average work only a few blows (perhaps three or four) are required in either the breakdown die or the finisher die. Between each of these blows the hammer man slightly lifts or tilts the partially forged end of the bar so that it will not "freeze" in the impression. This tilting also allows the surface scale to be removed by air or a steam blast. When working from the bar, a cut-off is attached to the smaller hammers on whichever side is most convenient for the operator. For larger work, the cut-off is attached to the press on the hammer side. When the blanks are cold-sheared to the proper forging size before heating, instead of being cut off from the bar during the forging operation, the hammer cut-off is not used—in fact no cut-off is provided on the larger sizes of hammers.

When working from blanks of a predetermined size, the work must be handled with tongs, the dies being so designed that a sprue or "tong-hold" is left for convenience in handling the hot forgings. This practice is always followed in making heavy parts. On this class of work a steam drop-hammer is preferable, because the blow delivered is firmer and drives the greater mass of metal contained in the blank into the impression more completely.

It should be borne in mind that under-cuts and transverse holes which can be produced in castings by means of cores are out of the question when it comes to making parts under the drop-hammer. The movement of the dies is limited to a vertical direction, and attempts to produce intricately shaped cavities by the use of mandrels, although often made, have never been successful. Although the drop-forging process has certain limitations, quite intricate pieces can be produced by the use of properly designed dies and by the application of only vertical blows, as some of the examples to be discussed in the next installment of this article will show.

It has been mentioned that the practice followed in various drop-forging plants conforms to the facilities for handling the work. For example, in breaking down a crankshaft blank, an edger may be used such as shown in Fig. 5 at *A* attached to the die, or, if more convenient, a bulldozer, Fig. 6, equipped with suitable bending dies, may be employed. Probably the best machine for bending a crankshaft blank, however, is a hydraulic press equipped for the

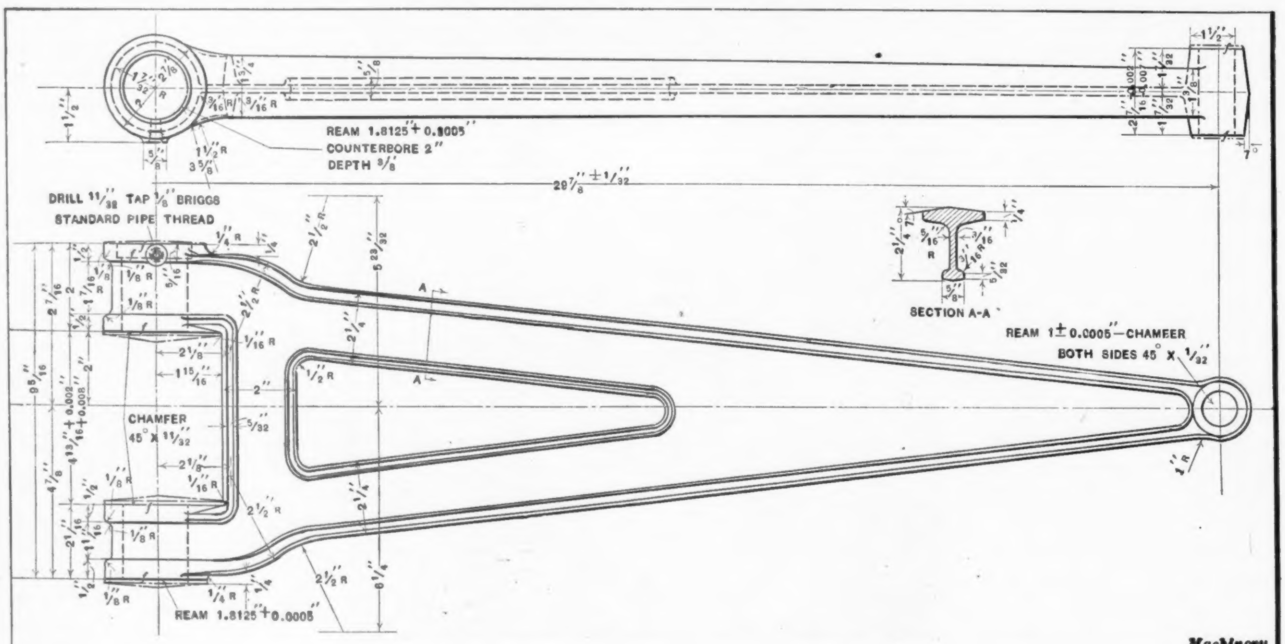


Fig. 7. Rear Axle Torque Arm drop-forged in the Dies shown in Fig. 8

purpose. Particular care must be exercised when using bending dies, to see that the benders are not of a design which is likely to cause rupture of the structure of the steel; for example, they should not be narrow and comparatively sharp.

In connection with the general reference to crankshafts for gasoline engines, it may be mentioned that the drop-forging of these pieces preserves a uniform fiber structure throughout all sections of the crankshaft, whereas if these shafts are hand-forged in the steam hammer the continuous grain structure is not obtained, because in hand-forging the arms and wrist-pins are machined from a solid slab of roughly forged metal. After the arms have been produced by cutting out the metal, the grain of the arms will be seen to extend transversely in relation to that in the drawn-out end bearings, and as a result the strength and the stability of the entire crankshaft are considerably lessened.

Variations in Size of Forgings

Although the die impressions may be accurately laid out, sunk, and carefully finished, as explained in the article "Design and Making of Drop-forging Dies," which was published in August and September MACHINERY, a certain amount of variation from the required sizes is unavoidable in drop-forging practice. The variation is due partly to wear and partly to unevenly distributed shrinkage resulting from peculiarities in design. Wear, of course, depends directly on the hardness of the steel being drop-forged. Tool steel (0.70 per cent carbon and over), must be worked at a lower forging heat than is advisable for an 0.20 to 0.30 per cent carbon mild steel, and this lower forging temperature in combination with the increased hardness of the steel causes an appreciable increase in the rate at which the die deteriorates. The allowance for wear, therefore, for hard, dense steels must be greater than for the low-carbon steels.

An example where the length of a forging is considerably affected due to excessive shrinkage is that of a gasoline engine connecting-rod. The typical connecting-rod design embodies two rather bulky bosses connected by a thin I-beam section. This unequal distribution of metal permits the large amount of flash on both sides of the I-beam section to cool quickly, which tends to draw the ends together, producing greater shrinkage than would otherwise result. On parts such as this, where the metal is unevenly distributed, the total shrinkage will be at least 5/32 inch in a center-to-center distance of 10 inches. Forgings such as these, however, do not shrink equal amounts. On a lot of 10-inch connecting-rods this variation will amount to as much as 1/32 inch, while for longer forgings such as crankshafts the shrinkage allowed when laying out the dies will vary in proportion to the length. For example, in a four-throw crankshaft having an over-all length of 43 inches, a variation of 1/16 inch or more from the intended length will probably occur. Such variation is, of course, unavoidable on parts that cool unevenly.

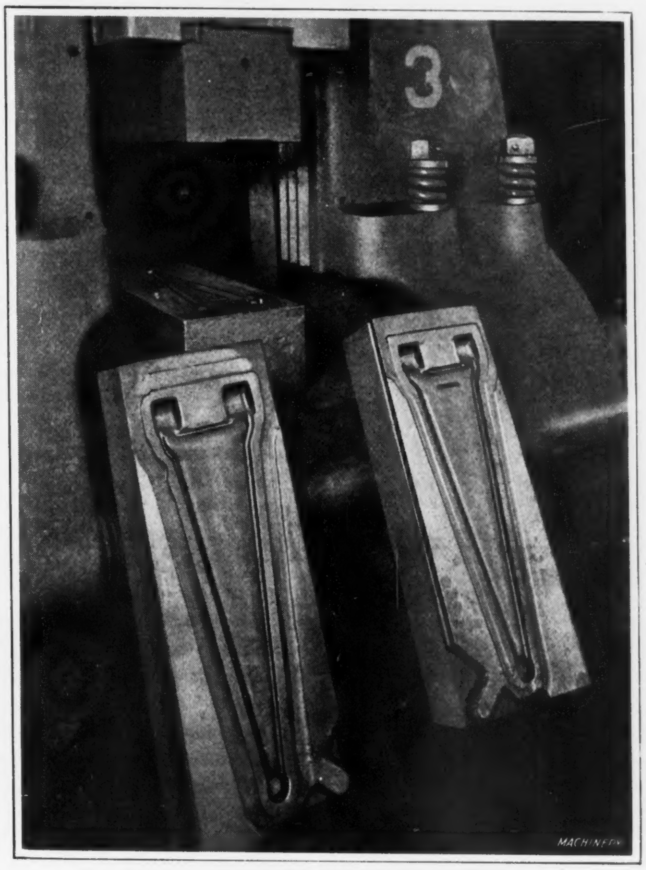


Fig. 8. Steam Drop-hammer and Dies for producing the Torque Arm in Fig. 7

The variation in thickness will depend somewhat on the shape and size of the piece, but will not ordinarily vary more than 1/32 inch and usually less in the smaller forgings. If greater accuracy than this is required, the impressions may be made over size, and the forgings restruck cold to size them after they have been trimmed. Often, no special dies will be needed for this sizing operation, the regular drop-forging dies being suitable. Type-bars for typewriters are usually sized in this manner and may be produced so that there will not be a variation in thickness of more than a few thousandths inch.

Another common cause for variation in size of drop-forgings is due to the metal not being worked fast enough, so that it has a chance to cool before the size of hammer employed can break it down and force the forging to shape. The result is that the dies do not come together as they should, and consequently the thickness or diameter is increased. This will also occur if there has been too great an allowance of metal in shearing the blank. Over-size blanks are also likely to produce cold-shuts by the metal being lapped over on the forging by the first blow or two of the hammer, and then being hammered in on subsequent blows. This trouble may be experienced if the blanks are under size, for in that case there is the probability of laps and seams showing at the parting line where the metal fails to fill the impression.

Bending, Drawing out, and Heading Work

The bulldozer is useful in a forge plant, for bending large work such as motor truck axles, etc. Preliminary bending operations of this kind can be handled on the bulldozer to advantage. The hydraulic press is also a valuable machine in the drop-forge plant, and is used for drawing out long tapered parts, such as the rear axle torque arm for a motor truck shown in Fig. 7. The forging is made from a piece of 0.20 to 0.25 per cent carbon steel, 3 inches thick, 6 inches wide, and 12¾ inches long. It is first drawn out to the approximate length and taper on a hydraulic press, and forged in a 5000-pound steam drop-hammer. The first operation is that of breaking down the drawn out blank and hot-trimming the flash from the outside of the forging. In the second operation the forging is reheated, finished, and the flash removed hot from the outside and from the triangular hole in the web, both the trimming operations being performed simultaneously by the use of a combination trimming die and punch. Fig. 8 shows an Erie 5000-pound steam drop-hammer set up for producing the finished drop-forging. The first-operation dies used in breaking down the drawn out blank are shown resting against the machine. The forging weighs 37 pounds.

The upsetter, variously termed a header and forging machine, is of vital importance for the production of numerous designs of drop-forgings. One of the most common uses for an upsetter is that of heading the end of a crankshaft to produce the flywheel flange. For such work, as well as for bending heavy hooks, the upsetter is commonly used, subsequent to the drop-forging operation.

How To Reduce Production Costs?

Drawing Dies for Manufacturing a Carburetor Bowl

By N. T. THURSTON, The Acklin Stamping Co., Toledo, Ohio

AN interesting series of operations was performed in the manufacture of the carburetor cup or bowl illustrated in Fig. 1. By drawing and forming this part on power presses, a substantial saving was effected over the previous method of casting the part. The later method of manufacture eliminated all cleaning and machining necessary when a casting was used. In addition, tolerances on the various dimensions were actually decreased, because it was possible to secure more accurate work and at a lower cost than when the part was cast. The appearance and dimensions of the part after each of the operations are shown in Fig. 2. One apparent obstacle to the successful drawing and forming of the part was the fact that a metal thickness sufficient to permit the drilling and tapping of a hole for a standard 1/8-inch pipe was required at the bottom of the boss. This difficulty was successfully overcome, however, by filling the inside of the boss with spelter as shown at *H*. All the operations on the part were performed on single-action straight-sided power presses.

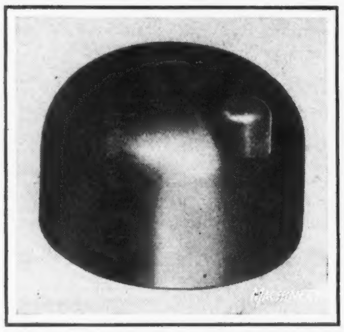


Fig. 1. Carburetor Bowl

The design adopted for dies used for drawing operations may make the difference between a substantial profit and a serious loss in the manufacture of an article. The study of successful die designs is therefore of the greatest value to the designer of press tools. By a slight modification in the design, an extra operation may be saved; and the quality of the product depends greatly upon the right proportioning of the successive operations. A press-tool designer can reduce the cost of manufacture to a great extent, and he is aided in so doing by studying designs that have proved successful elsewhere.

The material used in manufacturing this bowl was 0.050-inch hot-rolled strip steel of a good drawing quality. The strips were purchased from the mill in sizes 5 5/8 inches wide by 60 inches long, and before being used, they were well coated with slushing oil in a machine designed for this purpose. This oiling process was sufficient to permit the work to be put through the first three operations; it was then annealed and dipped in slushing oil prior to the fourth operation. The eight operations required to complete the part, and the dies used are described in the following.

Cutting the Blank and Drawing it to a Varied Depth

The combination die used to blank the part and draw it to the dimensions shown at *A*, Fig. 2, is illustrated in Fig. 3. It will be readily seen that the height of the shell varies around its periphery, the greatest difference being 11/32 inch, at points diametrically opposite. This result was effected by placing the draw-ring *A*, Fig. 3, eccentrically in relation to the die plug *B*, so that dimension *R* in the sectional view *X-Y* is greater than dimension *S*. This difference is not apparent on account of the great reduction necessary in making the illustration. If the draw-ring were concentric with the die plug, a shell of one depth would, of course, have resulted. Although there is a difference of 11/32 inch in the height of the shell, the difference between dimensions *R* and *S* only amounts to 7/32 inch. The extra 1/8 inch of height is produced by the stretching of the metal due to its being held more firmly on the side where the draw-ring is wider, than on the narrower side of the die.

Prior to a descent of the punch, the top of the draw-ring is on a level with the top of die part *D*, and as punch *E* enters the latter, the blank is cut and held firmly against the punch by the draw-ring during the remainder of the operation. Pins *C* are, of course, pushed down on the rubber buffers supporting them, and on the ascent of the punch, these buffers expand, forcing the draw-ring to follow the punch upward and thus stripping the shell from plug *B*. At the end of the upward stroke, the knock-out device *F* forces the shell from the punch, and as the shell falls on

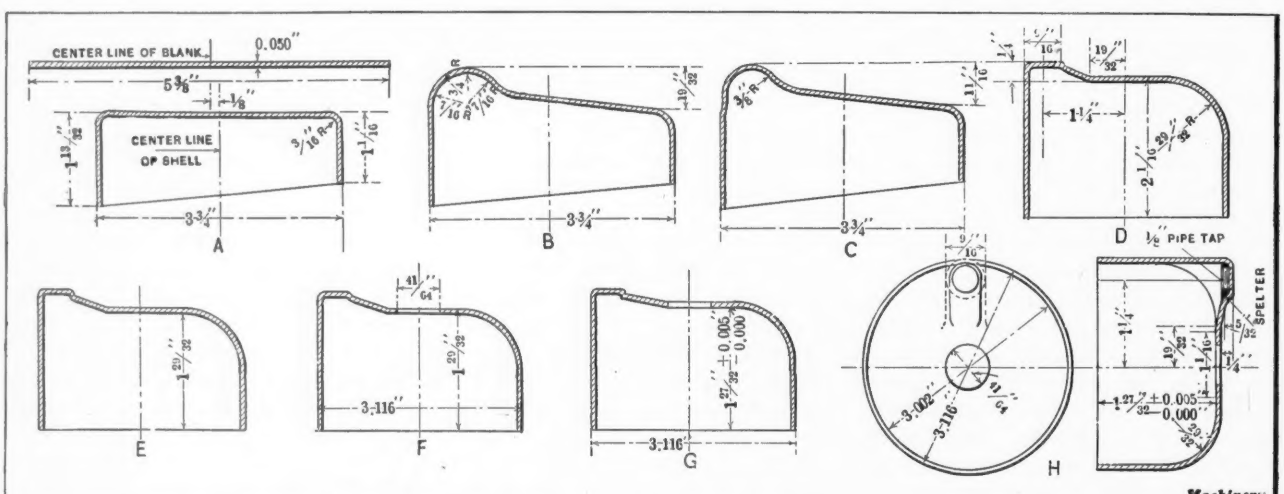


Fig. 2. Appearance and Dimensions of the Shell after Each Successive Operation

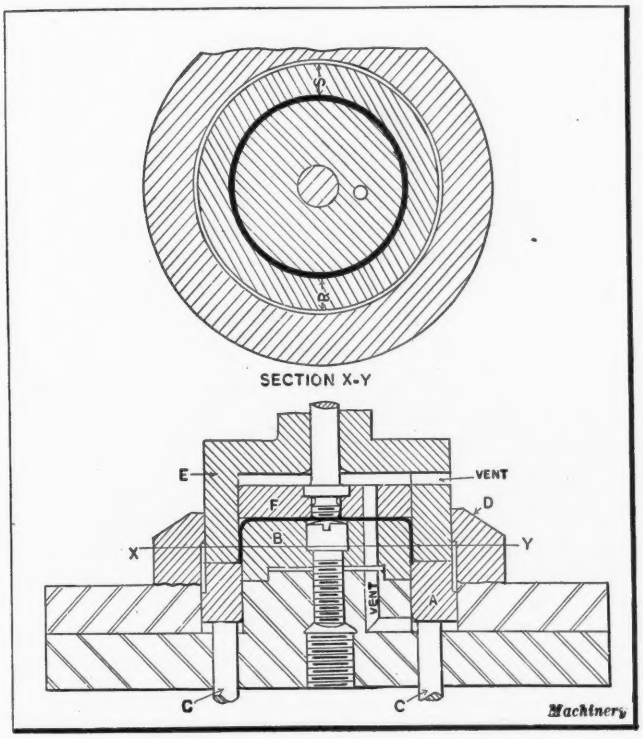


Fig. 3. Combination Die with Eccentric Draw-ring

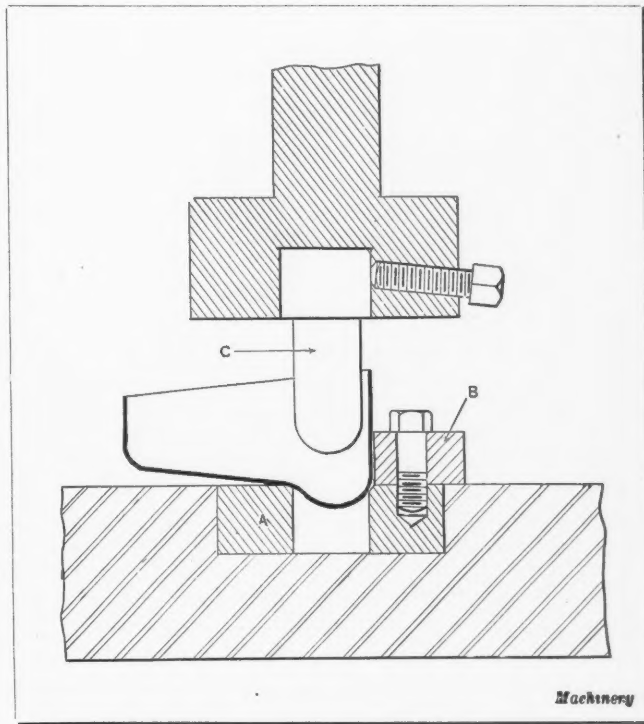


Fig. 4. First Embossing Operation on the Shell

top of the die, it is removed by the operator. Die part *D* consists of a machine steel base on which is forged a ring of tool steel. Punch *E* and plug *B* are also made of tool steel. Vents are provided in the punch and die to allow confined air to escape when the punch descends. A No. 57 Toledo press was used for this operation, and a production of about 4000 pieces per day was maintained.

Forming the Boss on the Shell

The second operation was an embossing one, the boss at the bottom of the bowl being made to the dimensions shown at *B*, Fig. 2. The construction of the die for this operation is shown in Fig. 4. The work is placed over the hole in the tool-steel ring *A* of the die, being located properly by means of stop-gage *B*, which is curved on the inside to correspond with the periphery of the shell. The die ring is mounted in a cast-iron base. The punch-holder is also made of cast iron and is carried in stock. Punch *C* is made of tool steel, so that all parts of the die which actually come in contact with the shell during the forming operation are made of tool steel. The punch is held in the holder by means of a set-screw inclined at an angle of about 2 degrees from the horizontal, which is a simple but satisfactory arrangement for keeping such a member in place. This operation was accomplished on a No. 5 Toledo press, and the production was about 6000 pieces per day.

The die for the next operation is shown in Fig. 5; this die increases the depth of the boss, and forms it to a smaller inside radius, as shown at *C*, Fig. 2. The construction of the die is very similar to the one for the preceding operation, with the exception that a stop-gage is not required. The shell is placed with the boss in the opening of the die ring and the die ring serves as a stop gage. The shell is held in place during this operation by the operator,

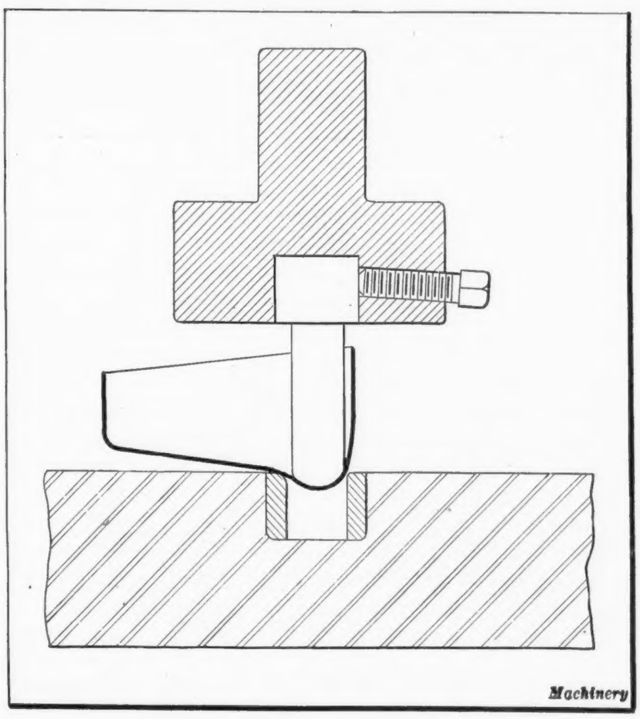


Fig. 5. Second Embossing Operation

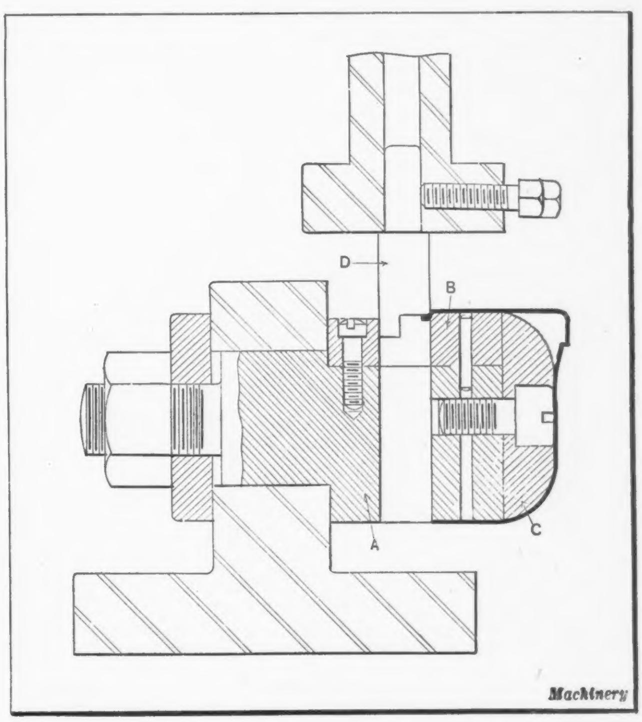


Fig. 6. Rough-trimming the Open End

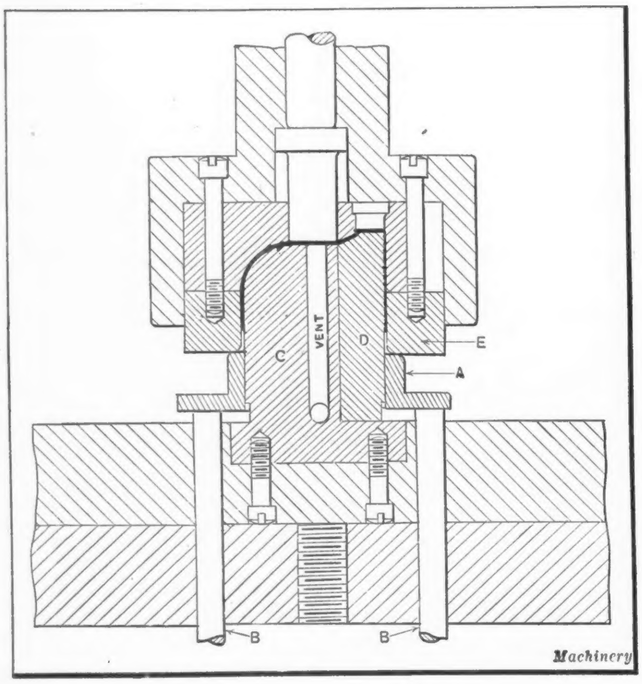


Fig. 7. Die used in drawing the Part to the Final Shape

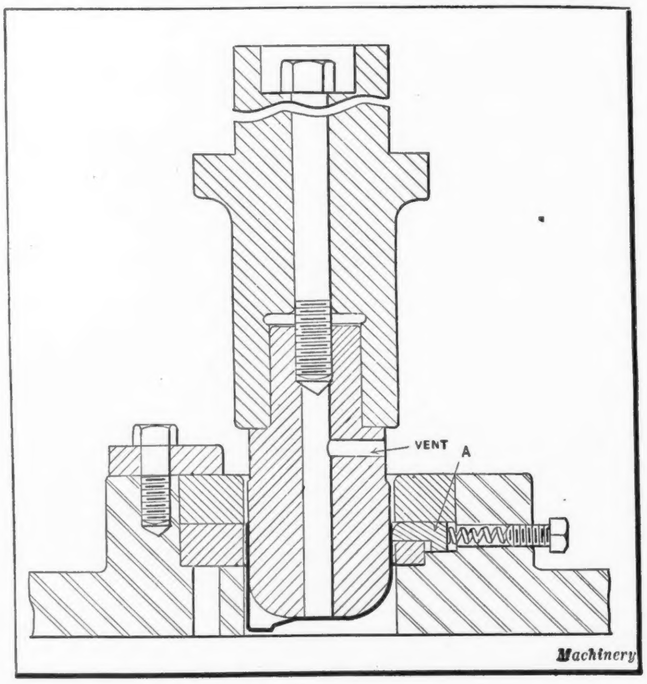


Fig. 8. Push-through Die used in sizing the Open End of the Part

who holds it at a point diametrically opposite the boss. The punch and die ring are made of tool steel, and the die base and punch-holder of cast iron. This die was also mounted on a No. 5 Toledo press, and the production was approximately 6000 pieces per day.

Final Drawing Operation

Prior to the fourth operation, it was necessary to anneal the shell thoroughly. The shell was heated to a cherry red, and the annealing was performed in a gas furnace after the shell had been dipped in a solution of one part of muriatic acid to five parts of water. This solution had no direct effect upon the annealing, but was applied for the purpose of loosening scale formed by the oxidation of the hot steel. When a part is annealed after being wet with such a solution, the scale which invariably forms can easily be removed by tumbling.

In the fourth operation the shell was brought to the final shape shown at *D*, Fig. 2; the die used for this operation is shown in Fig. 7. As in the case of the first die described, the draw-ring *A* is in a raised position before the punch begins to descend, due to the action of the rubber buffers upon which pins *B* rest. The work is then located by slipping it over the draw-ring, and is drawn on plugs *C* and *D* as the punch descends and draws the metal between the draw-ring and face *E* of the punch. The rubber buffers again expand as the punch ascends, causing the draw-ring to follow the punch and strip the shell from plugs *C* and *D*. The knock-out arrangement in the punch ejects the shell when the punch reaches the conclusion of its upward movement, and the work is caught on the end of a wooden paddle by the operator as it drops.

Die plugs *C* and *D* are mounted on a machine steel base, and the punch-holder is made of the same metal. All forming parts of the punch and die are made of hardened tool steel. A vent is provided through plug *C* for the escape of confined air during the operation. It will be noticed that two plugs are placed in the punch; one of these flattens the top of the boss, while the other flattens the closed end of the shell at the center. The view of the completed shell at *H*, Fig. 2, shows that a flat space 1 1/16 inch in diameter is required at this point.

This specification caused some difficulty when the dies for this operation were first tried out, the trouble being that the thickness of the metal at the bottom of the boss became several thousandths of an inch thinner than the thickness

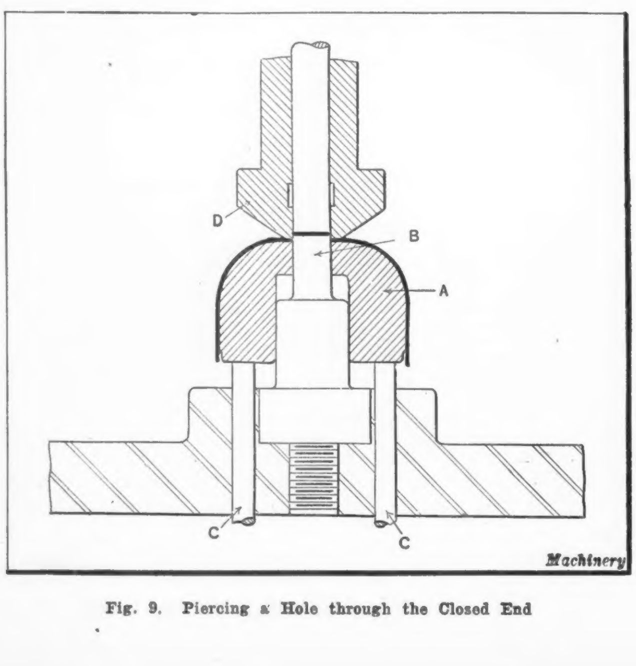


Fig. 9. Piercing a Hole through the Closed End

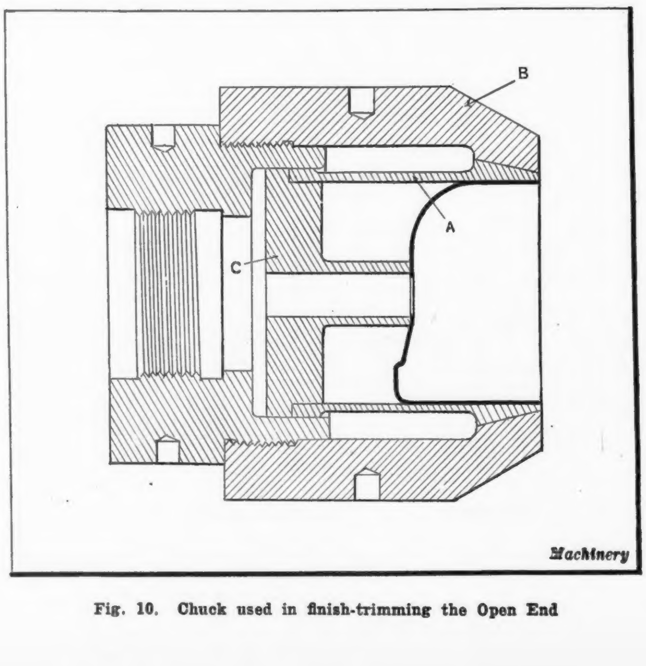


Fig. 10. Chuck used in finish-trimming the Open End

at the center of the closed end. While this condition had been anticipated, the exact thickness at the two points had not been estimated correctly. The result was that the bottom of the boss was not entirely flat. However, the condition was quickly remedied by grinding down the shoulder of the small plug placed in the punch above the boss, and thus lowering the plug several thousandths of an inch. The thickness at the center of the closed end and at the bottom of the boss as the shell was finally produced differed from 0.003 to 0.004 inch, the bottom of the boss being the thinner. The production of this part on a No. 57 Toledo press averaged 5000 pieces per day.

Rough-trimming, Piercing, and Sizing Dies

The fifth operation consisted of roughly trimming the open end of the shell, thus reducing its height to the dimension given at *E*, Fig. 2. This operation was accomplished by the die illustrated in Fig. 6. The base of this die and plug *A* are made of machine steel, but the plug is fitted with a hardened tool-steel block *B* which serves as a cutting edge. End *C* of the plug is also made of machine steel. Punch *D* is a hardened tool-steel piece, held in a machine-steel punch-holder of standard construction. In this operation, the shell is slipped over the plug and turned slowly by the operator while the punch is kept moving up and down, until the entire periphery of the shell has been trimmed. A production of about 2500 pieces was obtained with this die on a No. 3½ Toledo press. A far more efficient die for this sort of operation is a type known as the "Brehm," which is provided with cams that give it a rotary motion around its perpendicular axis. The expense of a die of this design, however, did not warrant its use in the production of the limited number of shells made.

The sixth operation sized the open end of the shell to the dimension shown at *F*, Fig. 2. This was found necessary, because, while the final drawing operation brought the top of the shell to size, it did not bring the open end to the proper dimension. The operation was performed on the push-through die shown in Fig. 8. This die is constructed in a manner assuring that the shell will pass through the die and not stick to the punch upon its upward stroke. The stripping of the shell is accomplished by means of three spring-plungers *A* which protrude into the opening of the die when the punch is in a raised position. These plungers are beveled at the top so that they are forced back flush with the internal surface of the die as the shell is pushed against them on the downward stroke of the punch. However, the pressures of the springs hold them against the outside of the shell, and as the open end passes them, the plungers are forced against the punch, thus enabling them to strip the shell from the punch when it ascends. The work is forced through the die by the next shell being sized. It will be seen that this punch is also provided with a vent. The die is mounted on a cast-iron circular base, and all parts coming in contact with the work are made of tool steel. A production of about 5000 pieces per day was obtained on a No. 55 Toledo press.

The diameter of the hole next punched at the center of the closed end of the shell is indicated at *F*, Fig. 2, and this operation is done by the piercing die shown in Fig. 9. It will be noted that the hole is pierced from the inside rather than from the outside. This method made it easy to dispose of the slugs punched from the shell, and permitted a simpler construction. The work is slipped over the machine-steel work-holder *A*, the top surface of which is on a level with the top of the tool-steel plug *B* when the punch is in the raised position, due to the action of pins *C*, which rest on rubber buffers. The hole is punched through the part as the tool-steel punch *D* descends and forces the work and holder *A* downward while plug *B* remains stationary. Each slug is knocked out of the punch at the end of the return stroke by the knock-out rod at the center of the punch. This piercing operation was performed on a No. 3½ Toledo press. The production was about 5000 pieces per day.

Final Trimming Operation

The shell was finish-trimmed to the height indicated at *G*, Fig. 2, in an operation performed on a small screw machine. The height of the shell was measured from the inside, and it will be seen that a tolerance of only 0.005 inch was allowed. If it had not been for the close limits, the shell could have been satisfactorily trimmed on a press equipped with a die similar to that used in the rough-trimming operation previously mentioned.

The chuck illustrated in Fig. 10 was made especially for this finish-trimming operation. Collet *A* is slit at four points for almost the entire length, so that it contracts when pushed against the inside tapered surface of sleeve *B*, thus securely holding work which has been inserted in the chuck. The collet is advanced by operating a lever on the side of the machine, which gives a horizontal movement to a sleeve bearing against the rear end of the collet member *C*. A knock-out rod extends through the hole at the center of member *C*, and forces the part from the chuck at the completion of an operation. Parts *A* and *C* are made of tool steel, while sleeve *B* is made of machine steel. This was the slowest operation of the series, but the production per day was about 900 pieces.

The spelter shown in the view of the shell at *H*, Fig. 2, was, as previously mentioned, placed in the bottom of the boss to give the latter sufficient thickness to permit the

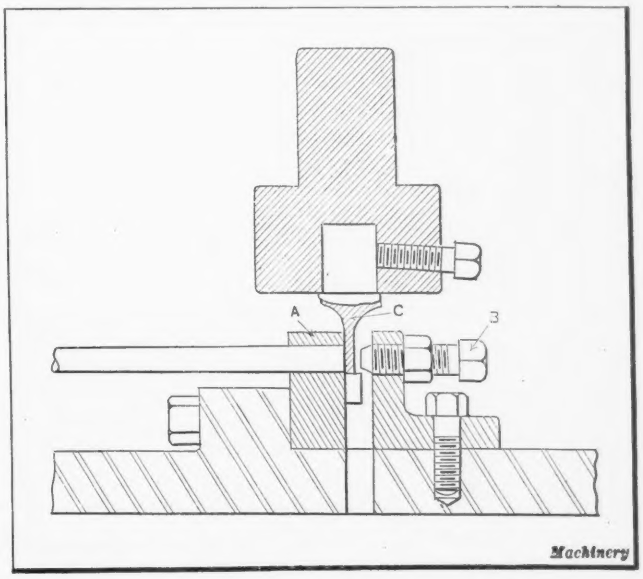
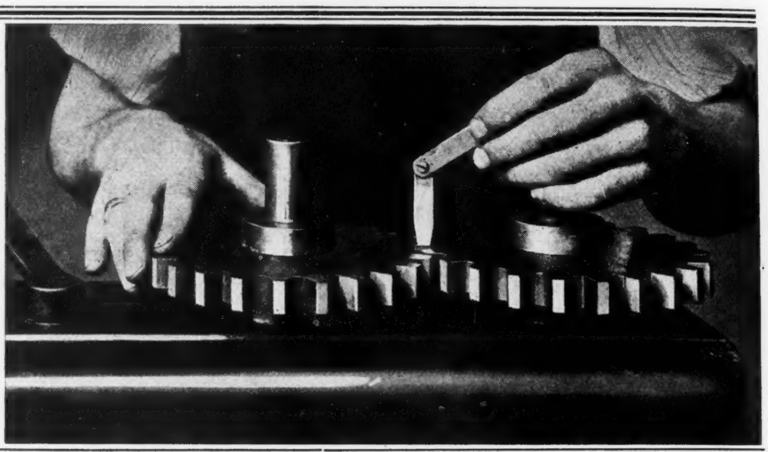


Fig. 11. Cutting the Spelter to the Proper Length

drilling and tapping of a hole to accommodate a pipe. The spelter was bought in rods ⅜ inch in diameter and 30 inches in length, and in order to cut the rod into small pieces of the proper size to fill the boss, the die shown in Fig. 11 was employed. The rod is fed through the tool-steel support *A* until it strikes the end of set-screw *B*, which serves as a stop-gage. The press is then tripped, and the descending punch *C* shears the spelter to the proper size. The die was mounted on a No. 3½ Toledo press, and the production was about 12,000 pieces per day. Punch *C* was, of course, made of tool steel.

The method used to fuse the spelter in the boss was simple, yet quite effective. The shell was placed on a small furnace with the open end upward, and the boss projecting through the top of the furnace into the flames. The work was kept in this position until the boss reached a red heat. A piece of spelter and a small amount of powdered borax were then placed in the boss and melted and fused in the steel shell. The latter when cooled was placed in a jig and a hole drilled through the boss. This operation was performed from the inside in order to prevent any danger of the spelter becoming loosened. The hole was finally tapped. All the dies described were designed, built, and operated in the shops of the Acklin Stamping Co., Toledo, Ohio.

Backlash in Hobbed Spur Gears



Amount of Backlash Recommended to Provide for Unavoidable Inaccuracies in Machining and Heat-treatment

By CARL G. OLSON, Chief Engineer, Illinois Tool Works, Chicago, Ill.

IN cutting gears, it is often required to make the teeth slightly thinner than the spaces between the teeth measured on the pitch circle. The backlash thus produced provides freedom between the involute curves to accommodate any slight inaccuracy produced in machining, heat-treating, and assembling. The backlash should be in proportion to the pitch, and it should also be governed by the accuracy of the process used for cutting the gears. Because of the continuous generating action of the process of hobbing, the highest accuracy can be obtained in spacing the teeth and in their concentricity; and this will permit a minimum amount of backlash to be used in hobbed gears. The backlash is usually obtained by cutting the teeth deeper than standard depth. In using the standard involute hob, this method is satisfactory in most cases, but it is not generally recommended on account of a slight increase in the under-cutting of the teeth of small gears and pinions.

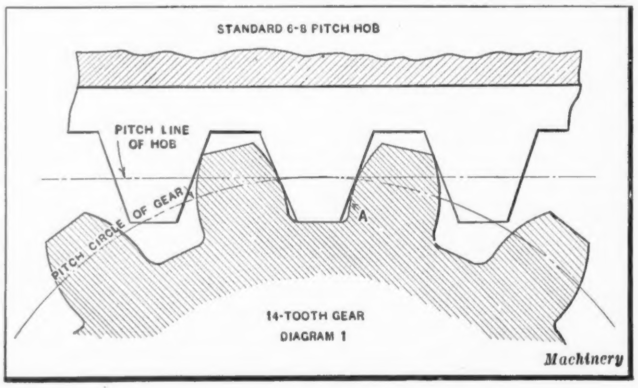


Fig. 1. Cutting Fourteen-tooth Gear of Standard Depth without Backlash

Special hobs formed to avoid under-cutting the teeth in the pinions should never be used to cut deeper than standard, but should be made with thick teeth to produce the desired backlash. The accompanying diagrams illustrate more clearly the reason for these recommendations. Fig. 1 represents a 6-8 pitch standard hob generating a fourteen-tooth gear having teeth of standard depth, and with no correction in the involute curve. The pitch line of the hob is tangent to the pitch circle of the gear, and the under-cut shown at *A* is very slight. This gear will have no backlash when running at the standard center distance with another gear having teeth cut to the same depth with the same hob.

For example, the recommended backlash for 6-8 pitch gears is 0.008 inch, and in order to produce this, it is necessary to feed the hob into each gear 0.0055 inch deeper than standard. The result is shown in Fig. 2, where the pitch line of the hob has been brought inside the pitch circle of the gear. However, it will be seen that the generating pitch line still remains tangent to the pitch circle of the gear and becomes a new pitch line, parallel to the measured or actual pitch line in the hob. The relation between the cutting edges of the teeth and the new generating pitch line remains the same, due to the fact that these cutting edges are straight lines and will still produce teeth with true involute curves. However, the added depth has increased the under-cut *A*, but this increase is very slight.

In Fig. 3 are shown two gears in mesh on standard center distances. These gears were hobbed 0.0055 inch deeper than standard, as previously recommended, and the backlash measured by the thickness gage inserted between the teeth

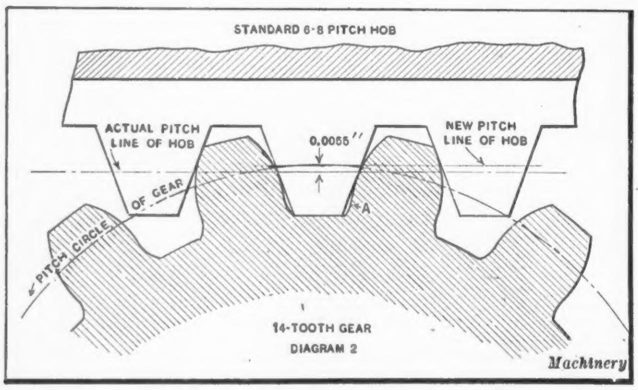


Fig. 2. Cutting Fourteen-tooth Gear Deeper than Standard to give Backlash between the Gears

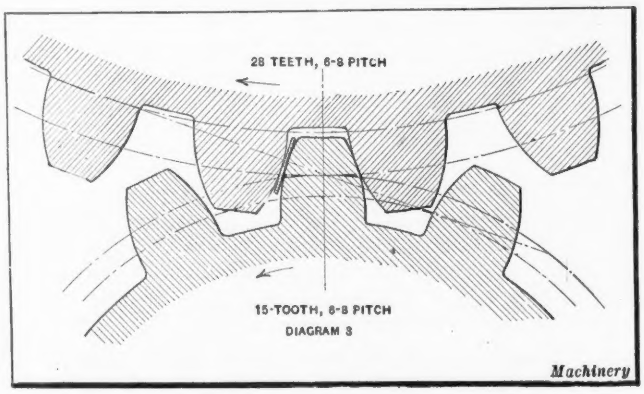


Fig. 3. Gears which have been cut Deeper than Standard to give Backlash

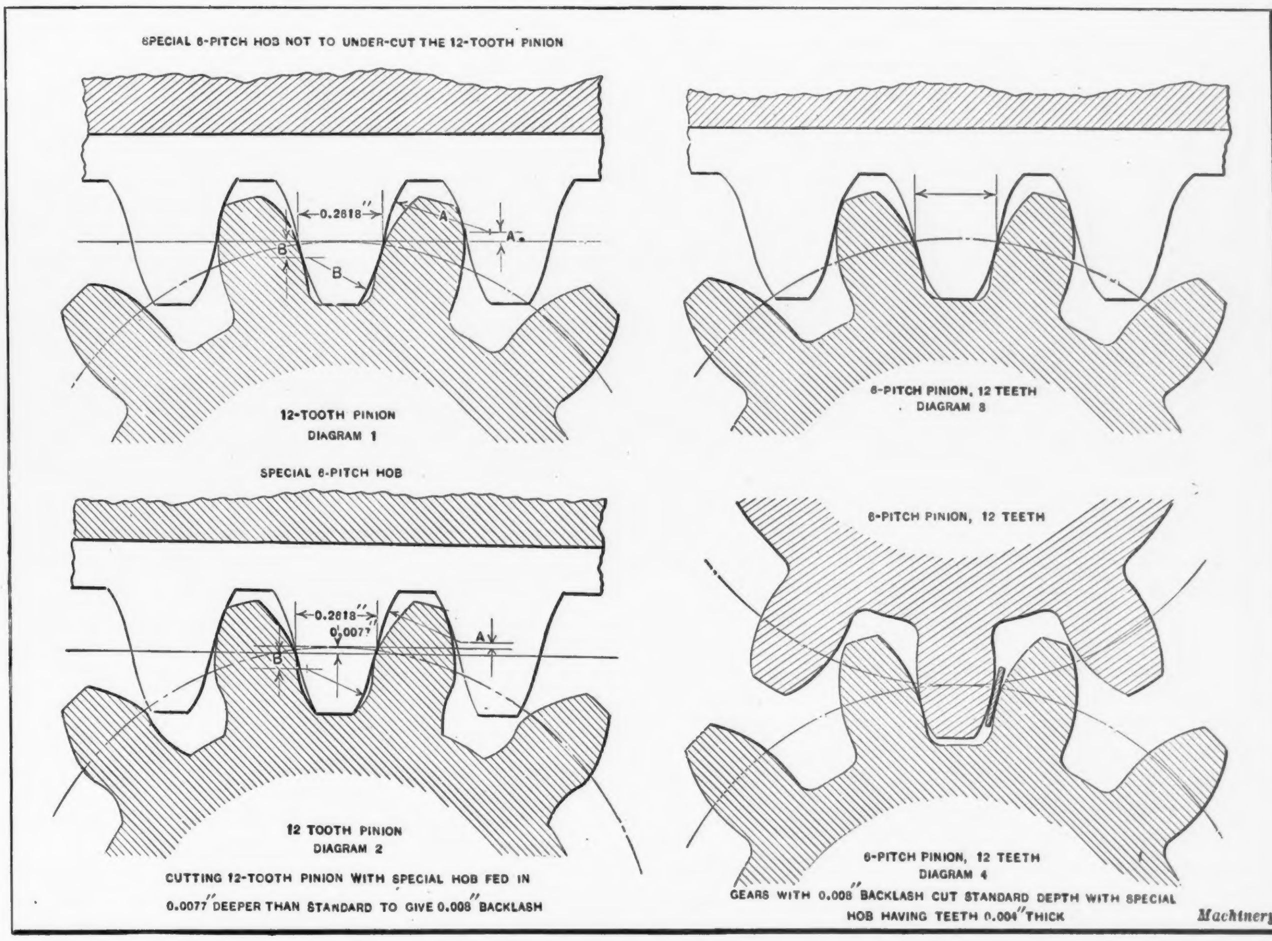


Fig. 4. (Diagram 1) Cutting Twelve-tooth Pinion without Backlash by the Use of Special Hob. (Diagram 2) Cutting Twelve-tooth Pinion with Special Hob Deeper than Standard to give Backlash. (Diagram 3) Cutting Twelve-tooth Pinion with Special Hob having Teeth Thicker than Standard to give Backlash. (Diagram 4) Gears with Backlash, cut to Standard Depth with Special Hob having Teeth Thicker than Standard

is found to be 0.008 inch. Fig. 4, Diagram 1, shows a hob designed not to under-cut the twelve-tooth pinion. The form of the teeth has been modified in fixed relation to the pitch line of the hob, as seen at *A* and *B*, and this will produce a corresponding modification in the fixed relation to the pitch circle of the gear. If it were attempted to cut deeper than standard with this hob, in order to produce backlash, we would have the condition shown in Diagram 2, Fig. 4. The recommended backlash is 0.008 inch, and as this hob has a 14½-degree pressure angle, it must be fed in 0.0077 inch deeper than standard. The relation of the modification has here been changed in relation to the new generating pitch line in the hob, and will no longer be correctly reproduced in the gear. The under-cut is more pronounced in this case, due to the fact that there is a 14½-degree pressure angle and a twelve-tooth pinion.

Diagram 3, Fig. 4, shows a 6-pitch hob made with teeth 0.004 inch thicker than standard, cutting a pinion with 0.008 inch backlash. This is the correct method, the appearance of the gear and pinion being shown in Diagram 4. This illustration also shows a gage placed between the teeth for measuring the backlash; this is done while the gears are held on studs of the correct center distance, as may be seen by reference to the heading illustration of this article.

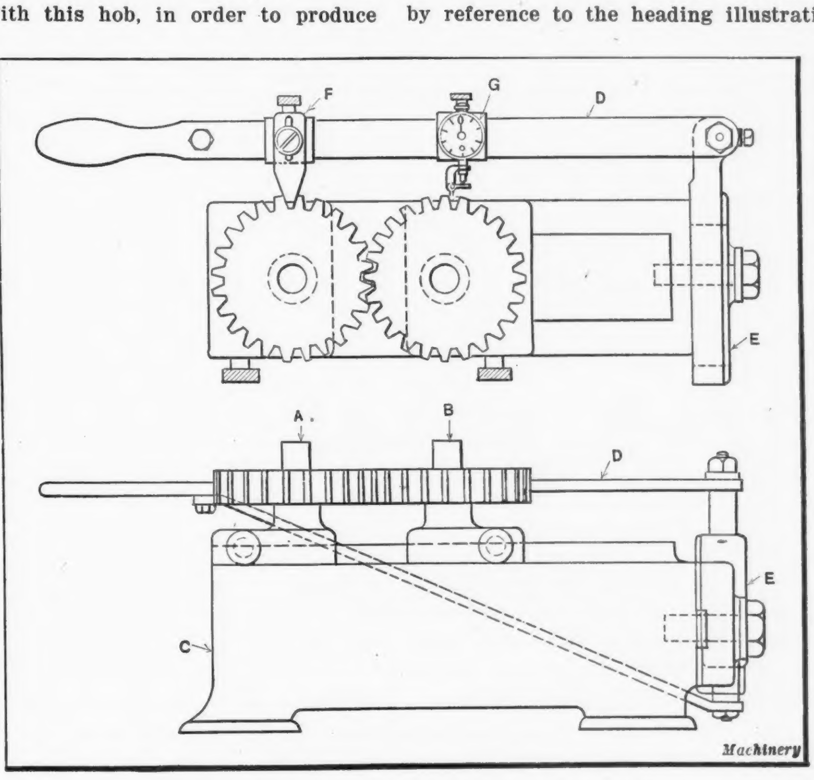


Fig. 5. Device for testing the Backlash of Gear Teeth

A fixture for rapidly and accurately testing the backlash of gears is shown in Fig. 5. The gears are mounted on studs *A* and *B* which may be adjusted on base *C* to any desired center distance within the capacity of the fixture. The center distance may be measured over the studs with a vernier caliper or a micrometer. Half of the sum of the diameters of the plugs should be added to the correct center distance for this measurement. A swinging arm *D* hinged to bracket *E* carries a stop *F* and a dial indicator *G*, both of which may

TABLE 1. BACKLASH RECOMMENDED FOR HOBBED SPUR GEARS

Pitch	Backlash, Inches	
	Average Condition	High-speed Gearing
3	0.014	0.007
4	0.012	0.006
5	0.010	0.005
6	0.008	0.005
7	0.007	0.004
8	0.006	0.004
9	0.005	0.003
10	0.005	0.003
12	0.004	0.002
14	0.004	0.002
20	0.003	0.001

Machinery

TABLE 2. AMOUNT HOB IS FED IN TO OBTAIN REQUIRED BACKLASH

Backlash (Inch)	14½-degree Pressure Angle, Full Depth		20-degree Pressure Angle, Stub Tooth	
	Added Depth	Difference from Standard Center Distance	Added Depth	Difference from Standard Center Distance
0.0010	0.0009	0.0018	0.0008	0.0017
0.0020	0.0019	0.0038	0.0014	0.0028
0.0030	0.0029	0.0058	0.0020	0.0040
0.0040	0.0038	0.0076	0.0027	0.0054
0.0050	0.0048	0.0096	0.0034	0.0068
0.0060	0.0058	0.0116	0.0041	0.0082
0.0070	0.0067	0.0134	0.0048	0.0096
0.0080	0.0077	0.0154	0.0055	0.0110
0.0100	0.0096	0.0192	0.0068	0.0136
0.0120	0.0116	0.0232	0.0082	0.0164
0.0140	0.0135	0.0270	0.0096	0.0192

Machinery

be adjusted to correspond with the center distance of the gears to be tested. The bracket *E* can also be adjusted to hold arm *D* in the correct relation to gears of differing diameters.

In using this fixture, the operator, with his left hand on the handle of arm *D* holds the stop tightly in contact with the teeth of the gear on stud *A* and with his right hand rocks the gear on stud *B*. As the indicator *G* is in contact with this gear, a direct reading may be obtained, showing the exact amount of backlash between the teeth of the gears. The test can be taken in several places to insure the uniformity of the gears. Table 1 gives the recommended backlash for hobbed gears of common pitches, and Table 2 gives the amount to feed the hob in deeper than the standard depth to get the required backlash. Table 2 is based on a table published in *Automotive Industries*, May 6, 1920. The added depth may be expressed by the following formula:

$$A = \frac{B}{4} \times \cot \alpha$$

where

A = added depth;
B = backlash; and
α = pressure angle

Gears cut with backlash may be brought closer together than the standard center distance. The difference is given in Column 3, Table 2, and this will be also found convenient for measuring.

* * *

CONGRESSIONAL HEARINGS ON THE METRIC SYSTEM

The congressional sub-committee of the Senate Committee on Manufactures, composed of Senator McNary, of Oregon, as chairman, and Senators Weller, of Maryland, and Jones, of New Mexico, will conduct hearings on the bill introduced in Congress providing for the compulsory adoption of the metric system. This bill provides that after a period of ten years, goods, wares, and merchandise, except for export, must be sold in accordance with the metric system, and that charges for transportation must also be made in accordance with this system. It is the intention of the sub-committee to have limited hearings at this time, so that those in favor of and opposed to this legislation may each state their cases. It is then intended to circulate as widely as possible a record of the hearing, with the idea of acquainting the public with the problems involved. Later, during the regular session of Congress beginning next December, it is planned to have further hearings, after which the committee will take action upon the bill. American manufacturers and business men are opposed to the introduction of the metric system into the United States because of the expense that a change would involve and the confusion that would necessarily follow. MACHINERY has repeatedly pointed out that the industries of the country are most vitally interested in the system of weights and measures used, and that it should be left to the industries themselves to determine what system they are to employ. Congress should not by compulsory legislation introduce a system that the industrial leaders, business men, and engineers of the country, do not want.

* * *

COOPERATION BETWEEN BRITISH AND AMERICAN ENGINEERS

Several hundred American engineers gathered with representatives of the principal engineering societies of Great Britain and France at a dinner at the Engineers' Club, New York City, on the evening of October 10. The event formally celebrated the homecoming of the distinguished American engineers who went abroad to confer the John Fritz medal upon Sir Robert Hadfield of London and Eugene Schneider of Paris. Heading this deputation, which in addition to the foreign representatives constituted the guests of honor, was Ambrose Swasey of the Warner & Swasey Co., Cleveland, Ohio, founder of the Engineering Foundation and past president of the American Society of Mechanical Engineers.

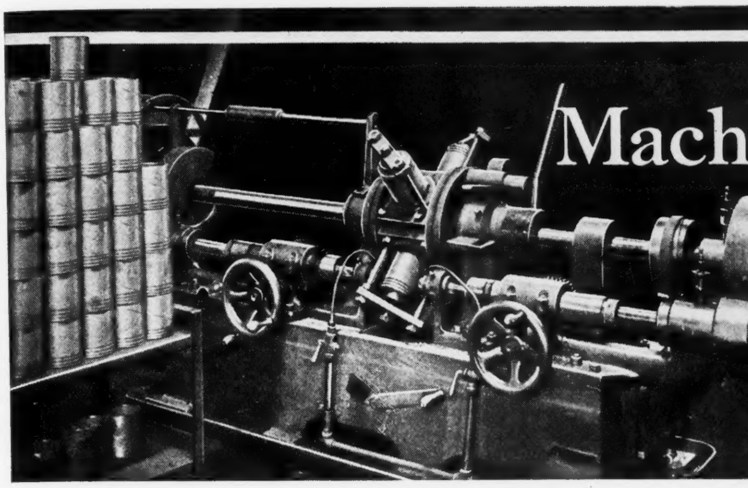
British organizations whose representatives were guests were the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Mining Engineers, the Institution of Mining and Metallurgy, the Iron and Steel Institute, the Institution of Electrical Engineers, and the Royal Society of London. France was represented by La Société des Ingenieurs Civils de France.

Close cooperation between British and American engineers already exists as the result of the visit abroad of the mission. Communication is now in progress as to the method of engineering organization in the United Kingdom and the Dominions. British engineers are planning a federation of the British societies, and are closely studying the developments in America which resulted in the formation of the Federated American Engineering Societies.

* * *

SAFETY CODE FOR COMPRESSED AIR MACHINERY

The American Society of Safety Engineers has been designated as sponsor for a safety code for compressed air machinery by the American Engineering Standards Committee. The code will include rules for the construction and use of compressors, tanks, pipe lines, and the use of apparatus where compressed air is the active agent. In accordance with the usual procedure, the code will be formulated by a sectional committee composed of representatives designated by the various bodies interested in this phase of safety work.



Machining Hudson Super-Six Pistons

Methods Used by the Hudson Motor Car Co. in Producing Pistons with High-production Machinery at Low Cost

How To Reduce Production Costs ?

THE pistons for the "Super-six" engines for automobiles built by the Hudson Motor Car Co., of Detroit, Mich., are made of cast iron. Many interesting methods have been developed for the machining of these parts, and excellent results are obtained through the application of automatic machines for performing certain operations.

As the castings are delivered to the machine shop, they are first subjected to a rough inspection; and they are then sent to a Gridley automatic on which the outside diameter is rough-turned, the closed end of the piston rough-faced, and the ring grooves rough-turned, the time per piece being about three and a half minutes. On this machine the turning tool *A*, Fig. 1, is carried by the back-rest, on which are also mounted two supporting rollers *B*. The closed end of the piston is faced by a tool *C*, mounted on the front slide; and the three tools which cut the piston-ring grooves are also carried on this slide, although they cannot be seen in the illustration.

In designing the cams, provision has been made for feeding the turning tool *A* from right to left, and at the same time when this tool begins its cut, the facing tool *C* also comes into action. The opposed position of these tools enables each to assist in preventing the pressure exerted by the other to spring the work out of place. As the turning tool *A* progresses toward the left-hand end of the work, facing tool *C* is also approaching the center of the piston; and toward the completion of the operation, the three piston-ring groove-turning tools come into operation. These tools greatly increase the pressure applied at the front of the work, and the tendency to throw the piston casting out of place is overcome by the two rollers *B* which are now in contact with the right-hand end of the work.

Rough-boring and Facing the Open End

After this preliminary operation, the castings are sent to a Fay automatic lathe on which the open end is rough-bored and rough-faced to the required length at a rate of about forty-five seconds per piece. These bored and faced surfaces are then used as locating points in setting up the work for subsequent operations.

In this article attention is called to the number of automatic machines and lathes that are employed for machining the pistons for Hudson "Super-six" engines. It is apparent that the equipment used aids in greatly increasing the rate of production and thereby decreasing costs; and in the present instance this is especially true because the machines have been equipped with an unusually large number of tools that are simultaneously engaged in turning, facing, boring, and other operations. With automatic lathes used in this way, it is safe to assume that the cost of machining these pistons is very close to the minimum attainable through the use of any available types of machine shop equipment.

Rough-drilling the Wrist-pin Holes

After the work on the castings has progressed to this point, they are delivered to a special drilling machine built by the Hoefer Mfg. Co., on which they are set up for rough-drilling the wrist-pin holes. This machine is shown in operation in Fig. 3. It consists of a turret *A* that carries castings *B* into position between two opposed spindles *C*; these spindles feed the drills in from opposite sides of the work, thus simultaneously drilling the holes through the two wrist-pin bosses. The spindles hold the twist drills in accurate alignment, so that the holes are drilled straight and in line with each other.

Each face of the turret is provided with a pilot that enters the previously bored and faced open end of the work, and there is a yoke over the casting, by means of which it is secured in place. The cross-bar *D* on the yoke has a C-slot in one end, which enables it to be pivoted about one of the side bolts *E*, so that the bar is brought into position over the casting to allow a nut on the second side bolt *F* to be tightened. The final clamping action is obtained by tightening the bolt *G* at the center, which forces a pressure pad down on the top of the work. The design of this machine is such that the drills *H* are automatically fed into the work, and the feed is tripped as soon as they have passed through the inner ends of the wrist-pin bosses. The spindles are then returned to their starting positions by turning handwheels *I* at each side of the machine; and the turret is indexed by hand to bring a fresh casting into the operating position.

After the operator has brought a new piece into place to be drilled, he occupies his time in removing the drilled casting which has made a complete circuit on the work-holding turret, and in setting up a fresh piece of work in its place. In this way, one drilled piston casting is secured for each index movement of the work-holding fixture, and the operator is kept busy unloading and reloading the machine while the drilling spindles are working on the holes in a piston casting which is in the operating position. As a result, the average time is only forty seconds per piece, and the idle time of both the machine and the operator is reduced to a minimum.

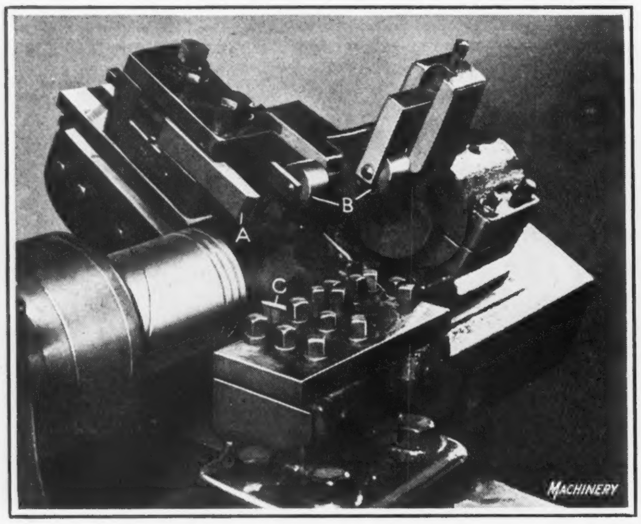


Fig. 1. Gridley Automatic equipped for rough-turning Outside Diameter, facing Closed End, and rough-turning Ring Grooves

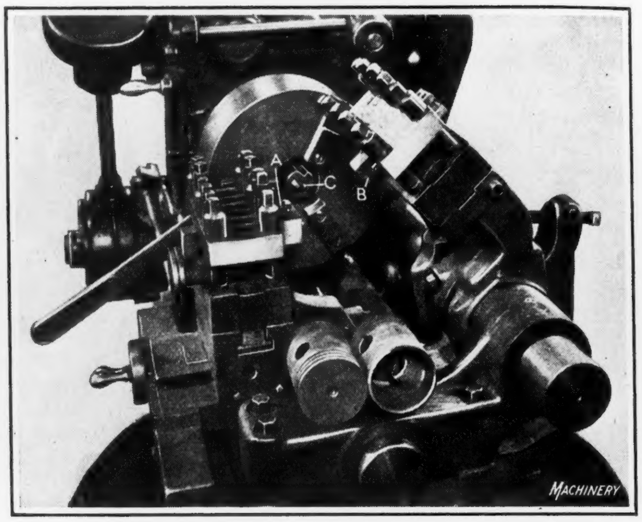


Fig. 2. Fay Automatic Lathe tooled up for finish-boring and facing the Open End, and centering the Closed End of the Piston

Finish-boring and Finish-facing Open End and Centering Boss on Closed End

After drilling, the castings are sent to the heat-treating department, where they are carefully annealed to remove strains that have been produced in machining; they are then sand-blasted on the inside to remove scale before being returned to the machine shop. This work is done in a Pangborn sand-blasting machine.

Next in the order of machining operations comes the finish-boring and finish-facing of the open end of the work, while the boss cast on the other end is centered and counterbored. This work is done on a Fay automatic lathe, equipped as illustrated in Fig. 2, at the rate of about forty seconds per piece. In this machine the boring is done by a tool *A* carried at the front of the cross-slide, while the facing operation is performed by a pivoted tool *B* at the rear. The centering and counterboring of the boss cast at the top or closed end of the casting is done by means of a tool *C* carried by a rod extending through the hollow spindle and actuated from the bar feed mechanism.

Another Fay automatic lathe, shown in Fig. 4, is then employed for finish-turning the outside diameter of the castings, taking a second roughing cut and a finishing cut in the ring grooves, and a finish-facing cut over the closed end of each casting, all of which requires about two minutes per piece. Referring to the illustration of the machine used for this purpose, it will be seen that on the front slide there are three tools *A* by which the finish-turning operation is performed on the outside diameter of the piston casting. For the intermediate- and the finish-turning operations in the piston-ring grooves, two sets of tools are provided, one of which will be seen at *B*. These tools are of somewhat the same form as the so-called "hob" used on a thread-milling machine of the type where the work makes one complete revolution in contact with a rotating cutter to complete an internal or an external thread-cutting operation. But in the present case the cutter does not revolve, the purpose of having a number of sets of teeth being to enable the tool to be loosened and reset with another set of teeth in the operating position. In this way, the cutter can be reset a number of times, as the teeth become dull, and it need only be sent to the tool-room for grinding when all of the teeth are dull. The tool that performs the final facing operation on the closed end of the piston will be seen at *C*, and it will be evident from the illustration that this tool is carried on the back-rest.

Recentering the Work Preparatory to Grinding

After the preceding turning and facing operations have been finished, the castings are sent to a special centering machine that is employed to recenter the open end of each piston, so that the work may be set up between centers for grinding. A special grinding machine was designed and built for this centering operation. In Fig. 5 a plug *A* with a knurled handle is slipped through the wrist-pin hole in the piston, to hold the center hole in the closed end of the work in contact with a center carried by the post *B*. Then, the formed grinding wheel *C*, which is mounted on a sliding spindle, is pulled forward into contact with the open end of the work by means of a handle *D* that has a yoke at its lower end, connected with a collar on the spindle. This is a very simple machine and one that gives entirely satisfactory results. After being recentered,

ORDER OF MACHINING OPERATIONS ON HUDSON "SUPER-SIX" PISTONS

Operation Number	Name of Operation	Type of Equipment Used
1	Rough-inspect	Bench
2	Rough-turn outside diameter, face closed end, and rough-turn ring grooves	Gridley automatic
3	Rough-bore open end and face to length	Fay automatic
4	Rough-drill wrist-pin holes	Special Hoefer drilling machine
5	Heat-treat	Gas furnace
6	Sand-blast inside	Pangborn sand-blasting machine
7	Finish-bore and face open end, and center closed end	Fay automatic
8	Finish-turn outside diameter, rough- and finish-turn ring grooves a second time, and face closed end	Fay automatic
9	Recenter open end	Special center-grinding machine
10	Rough-grind outside diameter	Fitchburg grinder
11	Rough- and finish-bore and ream wrist-pin hole	Warner & Swasey hand screw machine
12	Hand-ream wrist-pin hole	Bench
13	Face wrist-pin bosses	Whitney hand milling machine
14	Mill oil-grooves in wrist-pin holes	Sipp drilling machine with National oil-grooving tool
15	Grind clearance on sides	Norton cam-grinding machine
16	Drill six oil-holes through ring grooves	Avey sensitive drilling machine
17	Hand-ream wrist-pin hole to remove burrs	Bench
18	Rough- and finish-grind outside diameter	Norton cylindrical grinding machine
19	Inspect	Bench

Machinery

the castings go to a cylindrical grinder built by the Fitchburg Grinding Machine Co., which is used for grinding the outside diameter, the time required for the operation being approximately one and one-third minutes per piston.

Boring and Reaming the Wrist-pin Hole

Next in the order of machining operations comes the rough- and finish-boring and the reaming of the wrist-pin hole in the piston. For this purpose, the castings are sent to a Warner & Swasey hand screw machine which is equipped with a core-drill, a boring-bar, and a reamer to handle the required sequence of operations. The operation requires less than one and one-half minutes per piece. From this machine, the castings are sent to a bench where the wrist-pin hole is hand-reamed to assure obtaining accurate alignment.

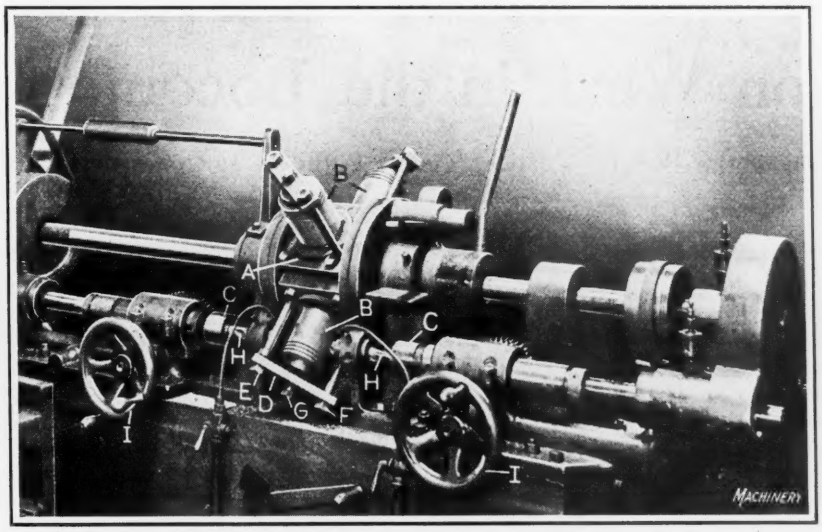


Fig. 3. Hoefer Special Opposed-spindle Duplex Drilling Machine for simultaneously drilling the Wrist-pin Bearing Holes in Piston Castings

Facing Wrist-pin Bearing Bosses, and Drilling Oil-holes

After this operation has been completed, the castings are sent to a hand milling machine built by the Whitney Mfg. Co., which is equipped with a work-holding fixture in which the castings can be located from the reamed wrist-pin holes; in this machine the inner ends of the wrist-pin bosses are milled by means of an offset attachment at the rate of nearly two a minute. Oil-grooves are then milled in the wrist-pin holes, at the rate of over three pistons a minute, with one of the No. 2 oil-grooving tools made by the National Machine Tool Co., carried in the spindle of an upright drilling machine built by the Sipp Machine Co.

Grinding Clearance at Sides of Piston

For grinding the clearance required at each side of the piston, at points where the wrist-pin holes come through, use is made of a Norton cam-grinding machine which is equipped with master cams of the same form as the cross-sectional area of the finished piston on a plane through the wrist-pin holes. Each piston requires about forty-five seconds for grinding. Next, six oil-holes are drilled through the piston in the ring grooves, using an indexing fixture on an upright drilling machine built by the Avey Drilling Machine Co. After this, the wrist-pin hole is hand-reamed to remove all burrs.

Rough- and Finish-grinding the Outside Diameter

The castings are next sent to a Norton cylindrical grinding machine, on which the outside diameter is rough- and finish-ground, one and one-half minutes per piece being the average time required. The pistons are then ready for assembly into engines as required.

* * *

WASTE BY FIRE LOSS

Carelessness is the main cause of the enormous loss due to fires in the United States. Our fire loss per capita is several times greater than that of any other civilized country in the world, and amounts now to about $300,000,000 a year—an amount almost sufficient to have provided for the building of the Panama Canal. Property loss is only one item. The human lives lost by fire amount, on an average, to 18,000 annually, while about 60,000 persons are injured by fire. Ultimately, the property loss is shared by every citizen of the country. Everyone has to help pay the $300,000,000 annually going up in smoke. Manufacturers should take active steps to impress upon employes the need for greater care in order to prevent fires, not only in the factories but around their homes as well. An educational campaign along these lines is of national importance.

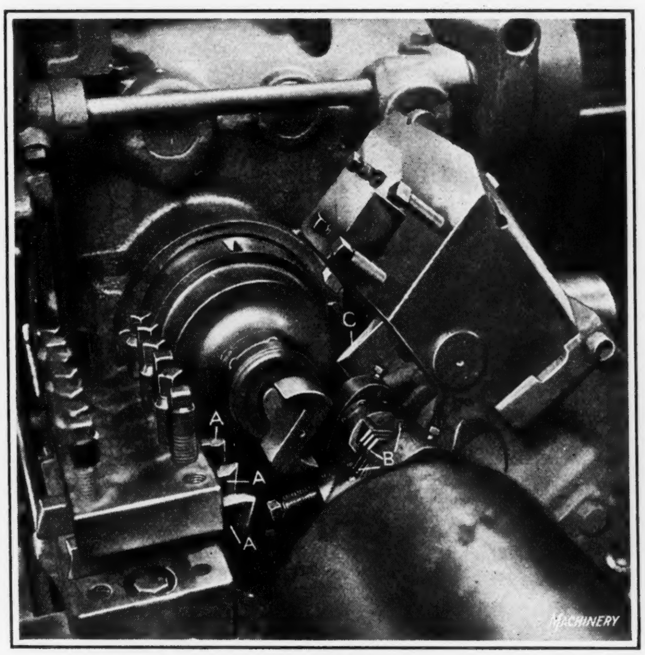


Fig. 4. Fay Automatic Lathe equipped for turning Outside Diameter, finishing Ring Grooves, and facing Closed End

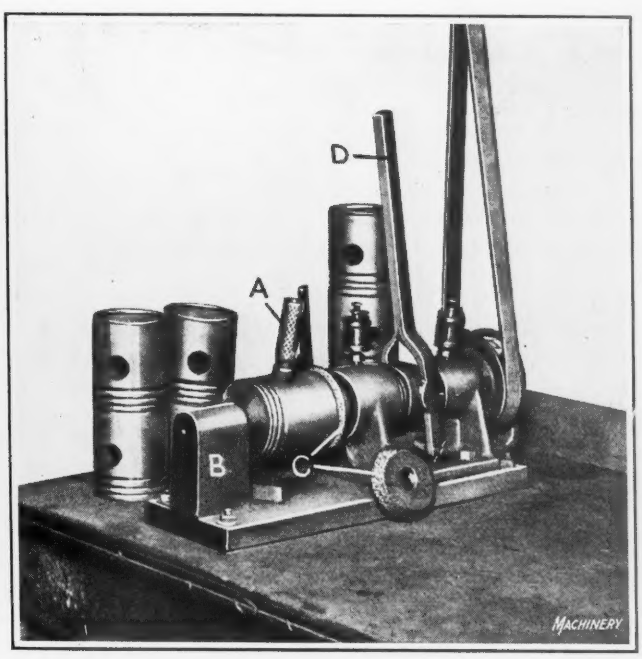


Fig. 5. Special Machine designed and built for Use in grinding the Center Bearing in the Open End of the Piston

Production Work in the Locomotive Shop

Application of the Bullard Vertical Turret Lathe in Locomotive Shop Practice
Second of Two Articles

The high cost of production in railroad shops has been the subject of many comments in both the daily and the technical press, in public speeches, and in governmental reports. Costs can be reduced in railroad shops in three ways—by capable management; by the efficiency of labor; and by the employment of labor-saving and cost-reducing machines and methods. The present article deals with the last phase, and shows a number of examples of economical production by the use of the vertical turret lathe in combination with carefully laid out tooling equipments.

IN the first installment of this article, published in October MACHINERY, the machining of piston-heads and rings and cylinder heads was described. In the present installment the tooling up for machining cross-heads, main throttle valves and piston-heads will be dealt with.

Tooling up for Machining Cross-heads

The machining of locomotive cross-heads involves a number of special tooling and chucking arrangements. A complete lay-out showing each operation in the three chuckings required to finish a cross-head of typical design is shown in Fig. 11. The first point of interest is the method of presenting the work to be machined. It is located between suitable jaws, and is supported by wooden blocks from the bottom, and by a screw-jack between the two sides, to prevent the upper side from springing while being machined.

In the second chucking, it is not practical to use jaws to hold the work, so a special fixture is employed. A tapered bushing *B*, which fits the central stud of the fixture closely, is placed in the previously machined hole of the cross-head, and the work is clamped in the position shown in the lay-out by means of a nut and washer *A* seating against the inner surface of the cross-head. This securely anchors the work in the proper position on the fixture. A driver *C* is clamped in a slot of the machine table so that the work will revolve positively with the table.

In the third chucking, another special method of holding the work is required; in this case a special fixture is used, which is provided with the same means for securing

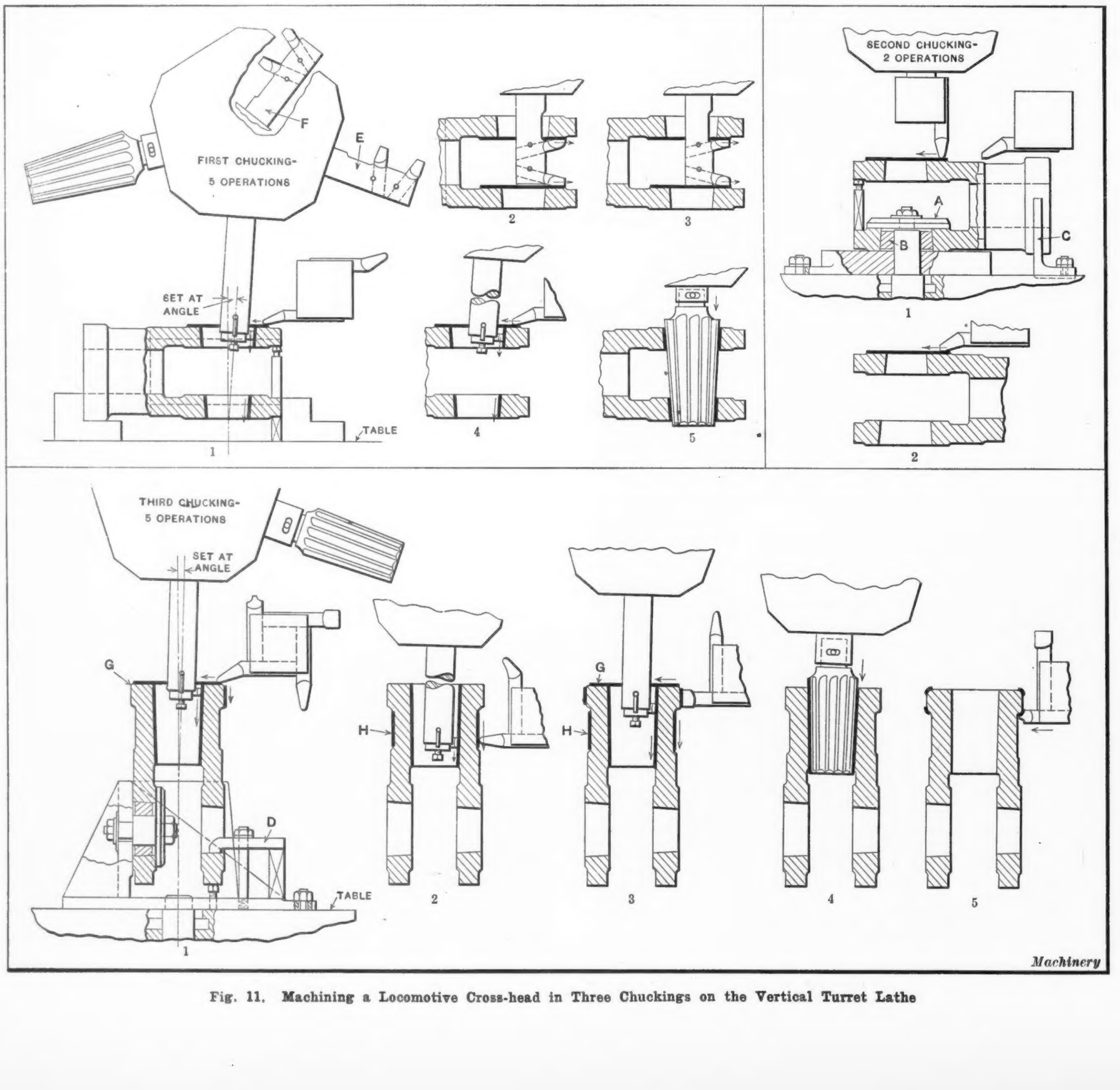


Fig. 11. Machining a Locomotive Cross-head in Three Chuckings on the Vertical Turret Lathe

the cross-head in position as was used in holding the work during the second chucking. Attention is also called to the use of a blocked-up strap *D*, which engages the small end of the tapered hole and binds the work down against an adjusting screw in the base of the fixture.

In machining the cross-head, the main turret is set at the desired angle, and in the first chucking, a combination boring-bar, equipped with a roughing cutter, rough-bores the tapered hole while the surrounding surface of this hole is rough-faced with a side-head turret roughing tool. The second and third operations are straddle-facing operations in which the special bars *E* and *F* are employed. The cutters are properly set in the bars, it being preferable to use two separate bars, one for roughing and one for finishing, rather than to change the cutters after the roughing operation. In the fourth operation, the tapered hole is trued up and the top surface finished by the tool in the side-head turret, as the lay-out indicates, while in the last operation of the first chucking, the hole is finished with a floating taper-reamer, by a method similar to the one employed in finishing the piston-heads, previously described. The second chucking consists of two operations, performed on the opposite side of the work. These operations are simply those of roughing and finishing the surface surrounding the tapered hole.

The cross-head is held in a vertical position during the third chucking, in which the piston-rod end of the cross-head is machined. In order to finish the tapered hole for the end of the piston-rod, the main turret is set at the required angle, while the hole is first rough-bored by a cutter carried in the boring-bar, and the surfaces of the head *G* are rough-faced and rough-turned with a side-head turret tool, as indicated by the arrows in the diagram. A second tool carried in the side-head turret is used in the next operation to rough-turn neck *H* while the remainder of the tapered hole is being rough-bored. The third operation is truing up the tapered hole by substituting another cutter for the roughing cutter in the boring-bar, and finish-facing and finish-turning the head *G*, and finish-turning neck *H* with a special tool carried in the side-head turret. A floating reamer is used in the fourth operation to finish the piston-rod hole, while in the fifth operation a double-radius formed tool carried in the side-head turret, is employed to form the radii of head *G*. This completes the machining of the cross-head, the total time being from 1½ to 1¾ hours.

Machining Locomotive Main Throttle Valves

The machining of locomotive throttle valves on vertical turret lathes is of interest principally as regards the holding method. Referring to Fig. 12, it will be seen that a special plate *A* is attached to the machine table, in which a tie-rod is carried. The work is located centrally in a special fixture by providing an extension *B* which is cast to the lower part of the valve stem and which fits into a hole in the fixture. By dropping a ring *C* into the upper end of the valve, provision is made for holding the work down by means of the tie-rods passed between the radial vanes, a positive driving arrangement being thus secured.

The machining of this valve requires two chuckings, as illustrated in the tooling lay-out. In the first chucking, the stem of the valve is rough-turned, and then the end of this stem is rough-faced with a special long-shank tool carried in the main turret tool-holder, this operation being performed simultaneously with the forming of the bevel and the roughing of the outside cylindrical surface by a tool carried in the side-head turret. The second operation finish-turns the outside of the stem and the shoulder at its upper end, while a special tool in the side-head turret is finishing the bevel at the top and finish-turning the outer surfaces which were roughed in the first operation. The position of the tool at the end of the finish-turning operation, when it reaches the lower flange of the casting, is indicated in the illustration. The third operation consists of finishing the angular surface at the lower part of the valve.

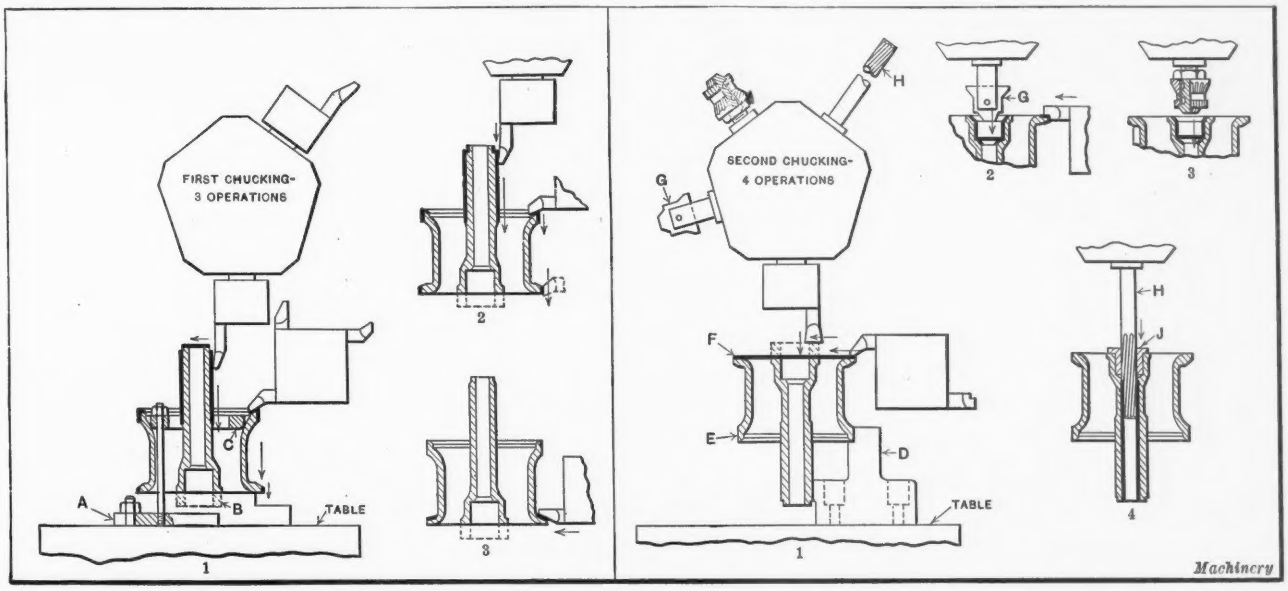


Fig. 12. Tooling Lay-out of the Two Chuckings required to machine a Main Throttle Valve for a Locomotive

In the second chucking, the work is secured by special soft jaws *D* which are so designed as to engage the work on the previously machined diameter *E* and on the extending end of the stem. The auxiliary boss which was cast on the valve stem for the purpose of locating the work in the first chucking, is turned off in the first operation by a tool carried in the main turret tool-holder. At the same time, the surface of flange *F* is faced by a tool carried in the side-head turret. As soon as the boss has been turned off, the same tool is used to face this end of the stem. During the second operation a special formed boring-bar *G*, rough-bores the counterbored hole in the end of the stem. This boring-bar is carried in the main turret, and while it is in operation, a radius-forming tool in the side-head turret forms the radius at the top of the flange. In the third operation a special reamer is employed to complete the machining of this counterbored hole. Finally, the central hole which passes entirely through the stem is reamed with a special length core-drill *H*, used in connection with a bushing *J* which fits into the counterbored hole as a means of securing perfect concentricity of this hole with the previously counterbored hole. These cast-iron throttle valves are about 18 inches in diameter, and are machined complete in from forty to forty-five minutes.

Compound Feed Gearing for Machining Angular Surfaces of Locomotive Piston-head

The tooling lay-out, Fig. 13, shows each operation in the two chuckings required to finish a locomotive piston-head all over, the special point of interest being the machining of the angular surfaces. Standard jaws and buttons are employed to chuck the work during each series of operations. Tools carried in the two turrets simultaneously rough-face surface *A* and rough-turn diameters *B* and *C*. In finishing the angular surface *D* during the second operation, a compound gear combination between the cross and vertical feeds of the machine is employed to traverse the main turret at the proper angle for machining the surface. While the angular surface is being machined, tool *C* of the side-head turret rough-faces the surface indicated by the position of the tool in the lay-out and also rough-faces the flange. For machining the tapered hole, the turret is set at the desired angle, and the boring-bar furnished with proper roughing and truing cutters, is employed. Simultaneously with the performance of this operation, a special hooked tool carried in the side-head turret finish-faces the top surface of the flange and finish-turns the adjacent shoulder, as indicated. The fourth operation consists of finishing the taper hole with a floating reamer while the bevel on the flange is being turned with a tool carried in the side-head turret. In the fifth and sixth operations, special formed tools, carried in the main turret, are used for rounding the edge of the hole and for blending the two curved surfaces.

The machining of more angular surfaces is involved in the second chucking, in which four operations are required to complete the machining of the work. With the feed gears properly compounded, the hub is rough-turned and rough-faced by the special tool *E*, carried in the main turret. While this tool is at work, the bottom flat surface of the flange is rough-faced and the outside diameter rough-turned by a tool in the side-head turret. Another angular setting of the main turret is employed in the second operation for finishing the angular surface *F*, while a hook-forming tool is carried in the side-head turret for finishing the radius. In the third step of the second chucking, the end of the piston-head hub is finish-faced while the end flat surface of the flange is being similarly machined with a hook tool carried in the side-head turret. The last operation required to complete the machining of this part employs a forming tool in the main turret to form the end of the hub and the same tool that was used in the third operation to finish-face the outside diameter of the flange. These heads are about 30 inches in diameter, and the total time required to perform the operations in which the parts are machined all over is from 1½ to 2 hours per casting.

* * *

BELGIAN MACHINE TOOL INDUSTRY

A report originally published by the Bureau of Foreign and Domestic Commerce relating to Belgian machine tool trade was referred to in August MACHINERY, page 1113. We are informed by a correspondent who has specialized for twenty-five years in the manufacturing and selling of machine tools in Belgium that several of the statements made in this report are erroneous. While it is true that there are only four important Belgian plants for machine tool manufacture, two of these are located at Brussels and two in Liége, and there is none at Bruges. There are also a few other firms of lesser importance making special machine tools. In addition to the plants manufacturing machine tools there are two factories engaged in the production of wood-working machinery.

Our correspondent states that modern Belgian wheel lathes are quite equal to the best American machines, and that Belgian manufacturers do not only imitate, but have also done a great deal of development work in machine tool manufacture. Some German machine tools are said to be quite equal to those built in America, and one of the largest dealers in Liége has sold Swiss, German, French, and Belgian machine tools to the entire satisfaction of his customers.

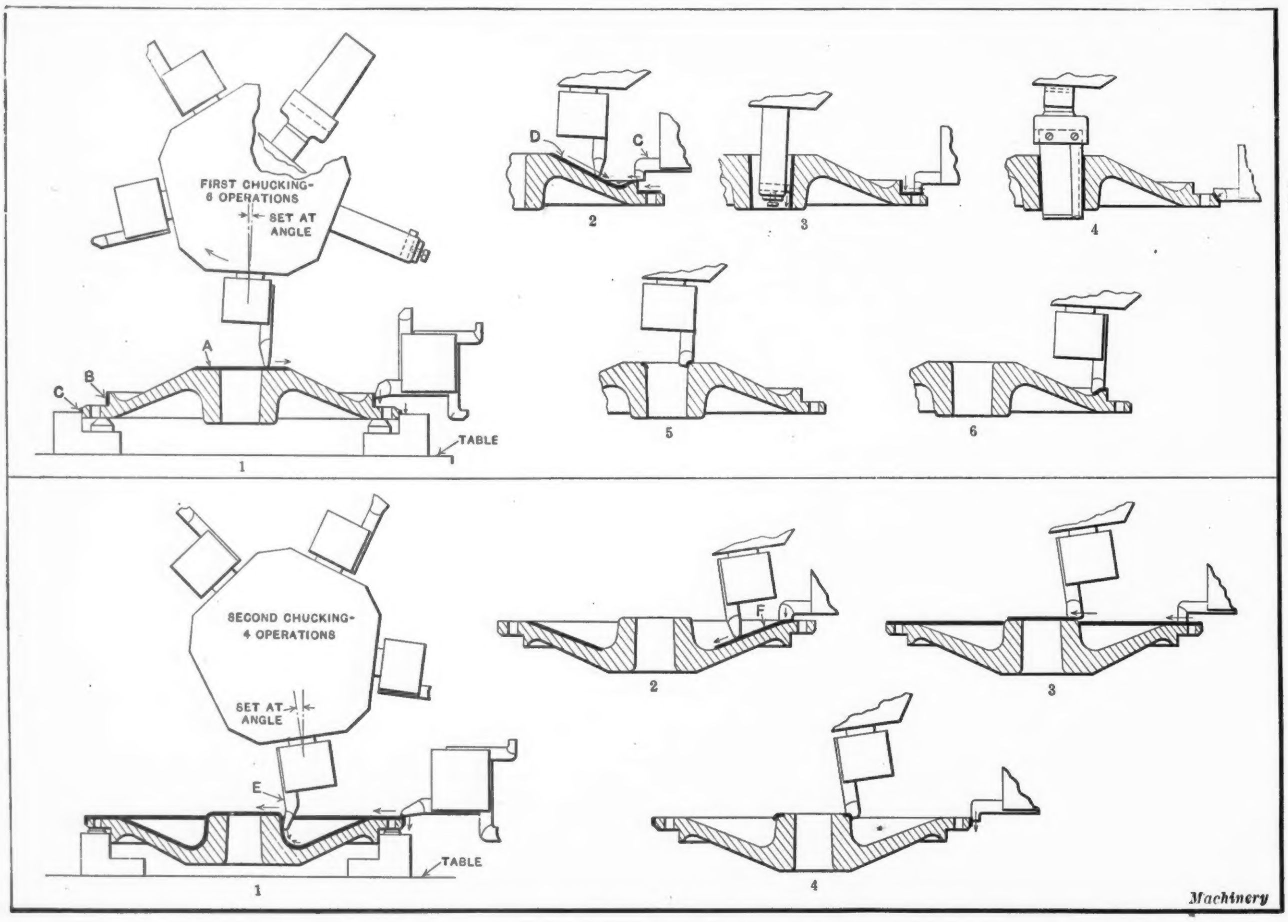
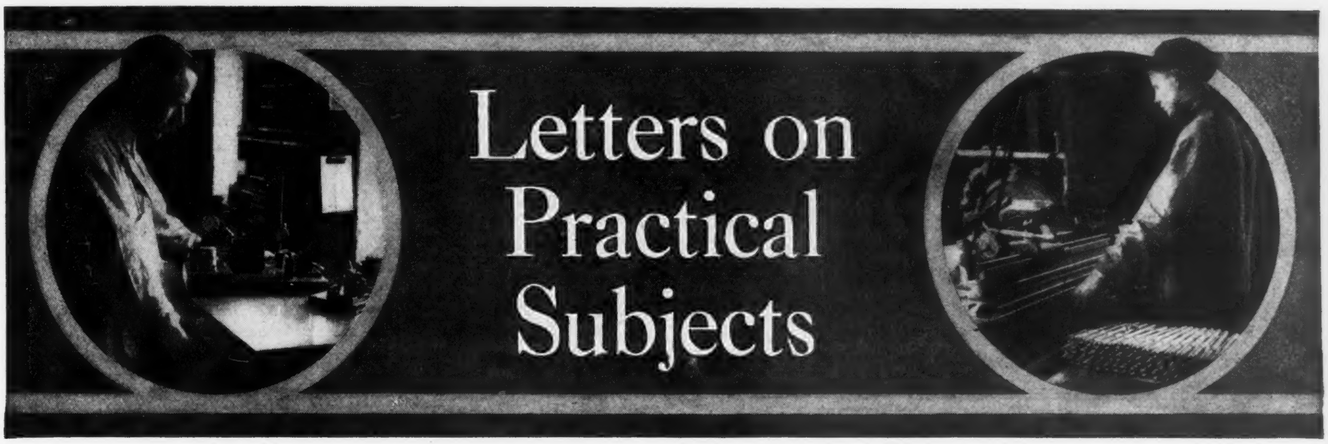


Fig. 13. Tooling Lay-out for machining a Locomotive Piston-head of the Mallet Type, showing the Method of machining Angular Surfaces



ADJUSTABLE REAMER BLADE FOR LARGE HOLES

The machining of two large holes in revolving-frame steel castings used in the construction of steam-shovels, resulted in the development of the floating reamer blade described and illustrated herewith. One hole was required to be reamed to 9⅞ inches in diameter and was to be a press fit for a bushing. This hole was 8⅞ inches long and extended through the casting. The other hole was 10 inches in diameter, reamed for a bushing, and 13 inches long. The holes were first bored on a large radial drilling machine, using a boring-bar and an inserted-blade cutter-head. This type of tool permitted the amount of adjustment required, and the boring operation caused no difficulty. Before the adjustable blade illustrated in Fig. 1 was used, the reaming was done with a single blade placed loosely in the boring head and permitted to float during the operation. Considerable difficulty was experienced, in that the blade had to be reground with every hole in which it was used, necessitating the re-hardening and redrawing of the blade each time it was reground. In addition to this extra work, the repeated heat-treatments often resulted in checks in the finished tool at the cutting edge, rendering it useless and requiring the making of a new blade.

These difficulties were overcome in the design of the blade illustrated in Fig. 1. This one blade, by its special adjustable feature, was also used for reaming both the 9⅞-inch and 10-inch diameter holes. It will be seen that the tool consists of two members, the male half *A* and the female half *B*, which are adjusted by a suitable screw and which are fastened together by a taper pin that fits in one of the two holes *C*. The two members are fitted together by a dovetail slide to produce a fairly good push fit, and a standard No. 8 taper pin secures the two members together and makes a rigid solid tool. The construction and dimensions of the fitted members are shown in Fig. 2. It will be seen that the tapered holes for the pin are located ⅛ inch closer together in one member than those in the other half, so that by the proper selection of holes the tool is made available for either of the two diameter holes in the work to be reamed.

In regrinding this blade it is simply necessary to remove the taper pin, disassembling the two members, and replace the pin in the male member *A*. By slightly relieving the extending portion of the pin by filing, as indicated in the illustration, the tool may be lengthened the same amount, or enough to allow for regrinding. It will be understood that as soon as the two members are re-assembled and the adjusting screw brought to bear against the end of the male member, a slight elongation of the tool is accomplished. It will be seen that this device eliminates all heat-treatment after the first hardening and makes it possible if the filing of the pin is carefully done, to oftentimes put the blade into proper shape by simply slightly honing the cutting edges. The blade does not work loose under the cut and causes no trouble. It is made of high-speed steel, the taper pins are of drill rod, and the set-screw is made from machine steel. The device described in the foregoing was designed by F. Springer. L. O. K.

CARE NEEDED IN USE OF MURIATIC ACID

A cup of muriatic acid, employed as a flux for soldering, was recently left over night on the tool-room bench near a new lathe, where it had been used by the writer. In the morning it was found that the lathe ways, and other scraped or polished parts, instead of being bright and shiny, were a dull brownish color. Investigation showed that other polished iron surfaces near the cup of acid were similarly affected, evidently by the acid fumes. The writer hopes that this will serve as a warning to others against leaving muriatic acid in an open receptacle near machinery having polished surfaces, as it requires considerable polishing to remove the rust caused by the fumes of this acid.

Boston, Mass. HOMER S. TRECARTIN

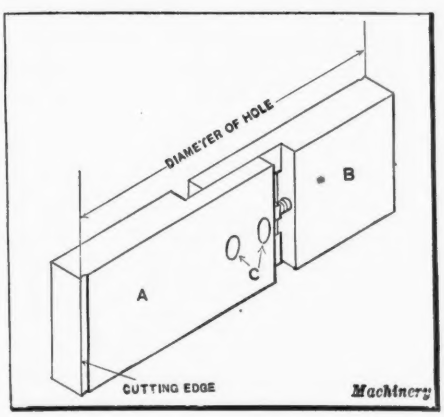


Fig. 1. Assembled Two-piece Reamer Blade

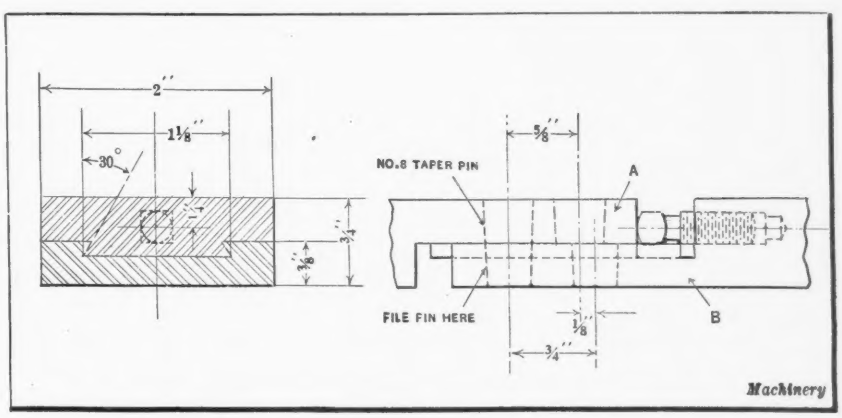


Fig. 2. Showing how Members are fastened together and adjusted

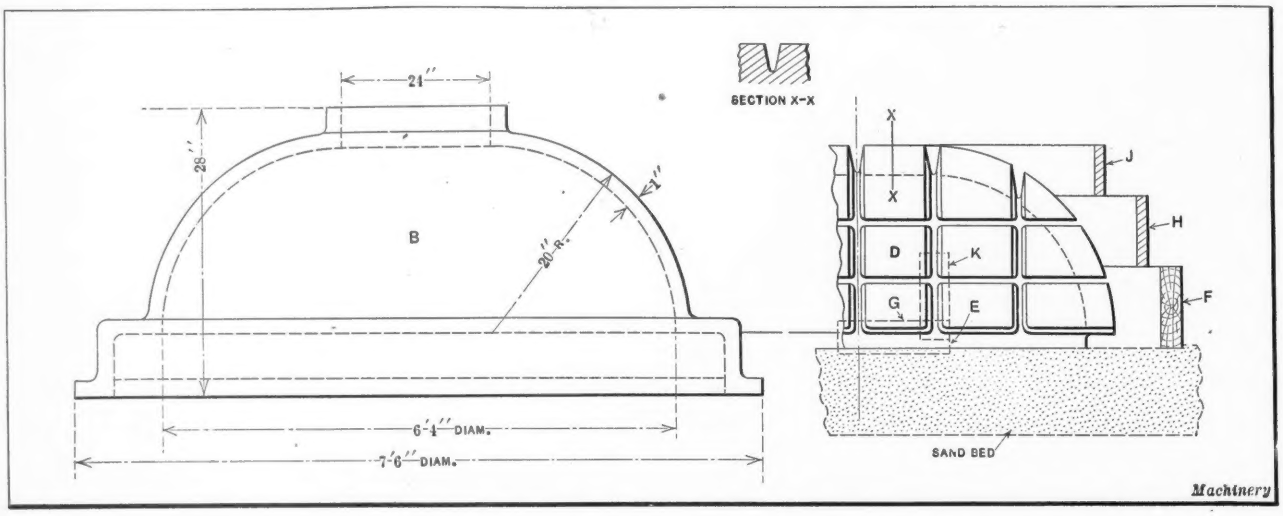


Fig. 1. Tank-head Casting and Method of molding Arbor or Sand-bar for Cope

MOLDING AN ARBOR OR SAND-BAR FOR A COPE MOLD

While on a visit to a foundry recently, the writer's attention was directed to the method employed in molding and casting the arbor or sand-bar *A*, shown in Fig. 2. This arbor was used in making the cope mold required in the production of the large tank-head casting shown at *B*, Fig. 1. The arbor was made without the use of a pattern other than that furnished for the tank-head casting. The pattern for this casting was of the simple built-up type, and was the same shape and approximately the same size as the casting to be produced, proper allowance, of course, being made to compensate for shrinkage. The molder, after looking the pattern over, decided that a very strong and rigid cope flask was required. He accordingly made a flask of steel which is shown at *C*, Fig. 2. The arbor or sand-bar *A*, required to support the heavy body of hanging sand that was to form the cope mold was next made. Ordinarily the maker of the pattern would be requested to furnish a pattern for the sand-bar, but as the casting was needed at once, the method of molding described in the following paragraphs was employed:

The pattern for the tank head shown in Fig. 1 was placed on a bed of molding sand, and the inside filled in with molding sand through the 24-inch hole at the top. When this molding operation was completed, the pattern was lifted, leaving a sand mold *D* of the form indicated at the right. At this stage there were not, of course, any grooves in the mold. With a piece of tin bent to the shape of the sand-bar, a cross-sectional view of which is shown at *X-X*, this body of sand was sectioned off by the eye, and at each section or division the sand was cut or gouged out as shown. The sand was next cut away at *E*, in order to form a flange ring at this point. When the gouging or cutting away of the mold that was to form the sand-bar had been completed, the wooden flask *F* was placed on the bed of sand. Small strips of tin, 4 inches wide and any convenient length, were placed on the mold over the grooves or slots.

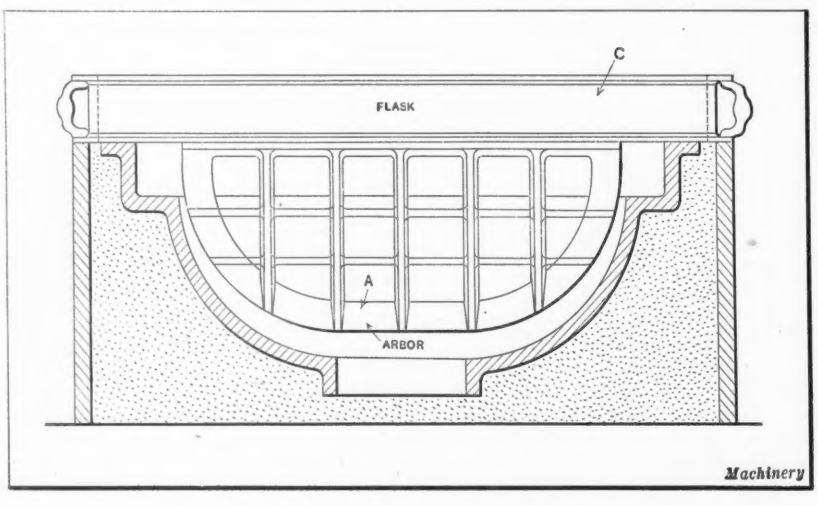


Fig. 2. Mold with Sand-bar or Arbor in Place

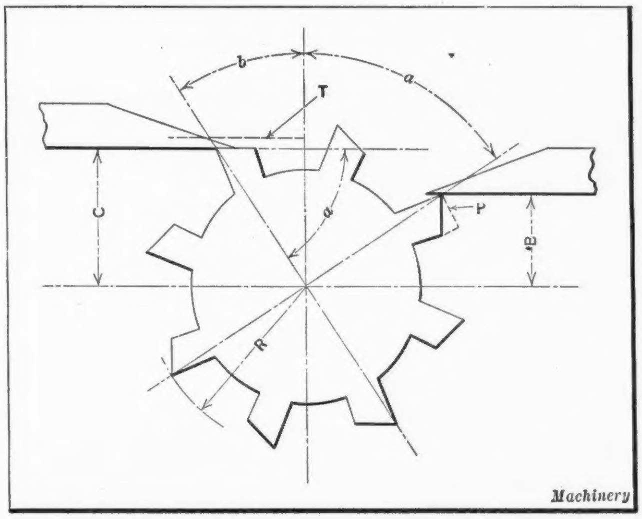
The first strips were placed over the flange-ring groove, as indicated by the dotted lines at *G*. The grooves at right angles with the horizontal grooves were also covered over with tin strips, the position of one of these strips being indicated by dotted lines at *K*. The sand was then filled in as in the making of a regular mold. Steel flasks *H* and *J* were stacked up as shown, pieces of tin being placed over the slots as the filling in and tamping progressed. When the sand had been filled in up to a level with the top of flask *J*, a pouring basin was formed at the top of the mold. This completed the mold, ready for pouring. The time required by the molder and his helper for making the mold was fourteen hours. The arbor or sand-bar casting *A* made from this mold was bolted securely to the flask, as shown in Fig. 2. The making of the mold for the tank-head casting then proceeded in the usual manner.

Kenosha, Wis. M. E. DUGGAN

MILLING TEETH OF ESCAPEMENT WHEEL

The following method of locating the work when milling the teeth of an escapement wheel was used by the writer with excellent results. A simple adaptation of this method also proved to be the best means of inspecting the work, as the faces of the teeth were so narrow that a sine bar could not easily be employed. The procedure followed in locating and milling the teeth was as follows: The recesses or spaces between the teeth were first milled, then the tops of the teeth, as shown by dotted lines *P*, were milled to radius *R*. The work can also be turned to diameter before milling.

The locating of the work for the operation was the difficult part of the job. After carefully removing the burrs from the work, leaving the corners sharp (although a slight rounding at the points of the teeth would probably affect the accuracy but little), the work was mounted on the dividing head and was rotated until measurement *B* was made to equal $R \times \sin b$. After clamping the work in this position, a trial cut was taken at the approximate height indicated by dotted line *T*. The height of *T* above the center



Method of setting up Escapement Wheel to obtain Correct Tooth Angle

line of the wheel was next measured by the use of a height gage, and the depth of cut required to finish the milling operation was obtained by subtracting dimension C from this measurement.

As an example showing how the calculations are performed let angle $a = 60$ degrees; $b = 30$ degrees; $a + b = 90$ degrees; and $R = 0.375$ inch. Then

$$B = R \times \sin b = 0.375 \times 0.5 = 0.1875 \text{ inch}$$

and

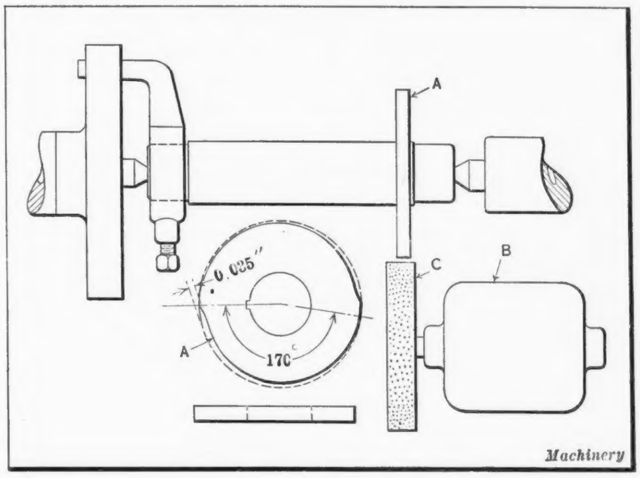
$$C = R \times \cos b = 0.375 \times 0.8660 = 0.3247 \text{ inch}$$

Cincinnati, Ohio J. F. THORNTON

GRINDING A SPECIAL CAM

The special cam shown at A in the accompanying illustration was ground on a lathe by the use of a portable motor-driven grinder and a taper-turning attachment. The cam is about 3 inches in diameter, 1/4 inch thick, and is of hardened steel. The edge or the contour is in the form of a double spiral, and the high degree of accuracy required made it necessary to use considerable care in grinding this edge. The piece was mounted on an arbor held between the lathe centers as shown, and the spiral ground by using a taper attachment and gearing the lathe as for screw cutting.

The 0.035-inch rise in the 170-degree sector was obtained by gearing the lathe for 2 threads per inch or, in other words, advancing the carriage 1/2 inch for each revolution of the work, and setting the taper-turning attachment to give a taper of 0.074 inch per inch, which is the rise or pitch in one complete revolution required to give a rise of 0.035 inch when the work is rotated through an arc of 170 degrees. The lathe can be geared for a finer pitch or lead,



Method of grinding a Special Cam

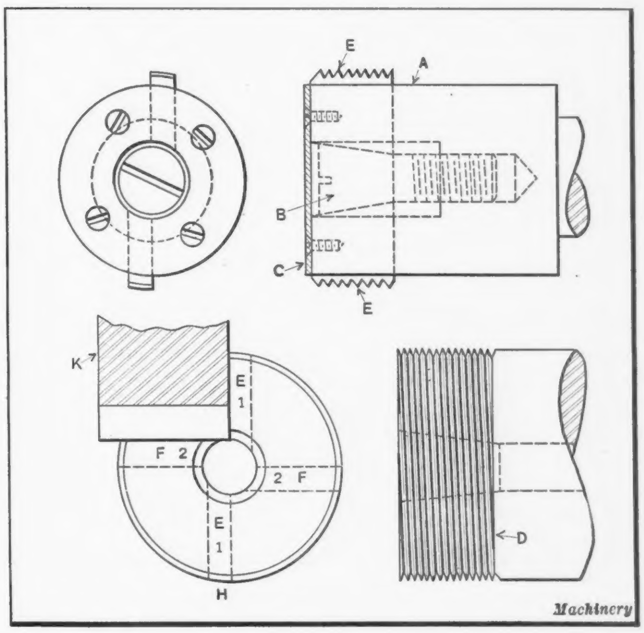
but this would necessitate setting the taper attachment to an angle which would be rather steep. The motor of the portable grinder employed is shown at B and the grinding wheel at C. The carriage on which the motor is mounted (not shown in the illustration) is run back and forth the same as in screw cutting. The compound rest is employed to feed the grinding wheel to the work.

A lathe without a taper attachment was used in a similar manner for grinding a small cam by setting the tailstock over, as in turning tapers. In this case the compound rest was set in line with the arbor. If it were necessary to grind a sharp corner at the point of drop in the cam, this could be accomplished by setting the grinding wheel in such a position that its face would cut at the upper corner only.

Providence, R. I. JOHN T. SLOCOMB

ADJUSTABLE TAP

The adjustable tap shown in the upper view of the accompanying illustration was designed for tapping brass elbows to be assembled on pipes. The diameter of the threads on different lots, or orders of pipe, varied to such an extent that it was necessary to increase or decrease the diameter of the threads in the elbows to obtain the proper fit. Accordingly, the tap shown was provided with means of making sufficient adjustment to compensate for the maximum variation in the diameters of the pipe threads.



Adjustable Tap, and Blank from which Chasers are made

The tap consists of body A, a cone-shaped adjusting screw B, chasers E, and a cover plate C. The chasers were made from a piece of tool steel D which was threaded in a lathe to correspond with the nominal pitch and size of the required thread. Before removing this piece from the lathe, a tapered hole was bored to fit the taper of the adjusting screw B. After completing the threading and boring operation, piece D was placed on a milling machine and four cuts were taken. A section of the milling cutter is shown at K in the position which it occupied when taking the first milling cut. By properly indexing the work after each cut the metal was finally cut away so that only the four chasers E and F remained. These chasers were stamped with the numbers 1 and 2, as indicated in the view at H, after which they were hardened. It will be noted that two sets of cutters were obtained from one piece D, but of course only two chasers having corresponding numbers were used in the tap at the same time.

Rosemount, Montreal, Canada HARRY MOORE

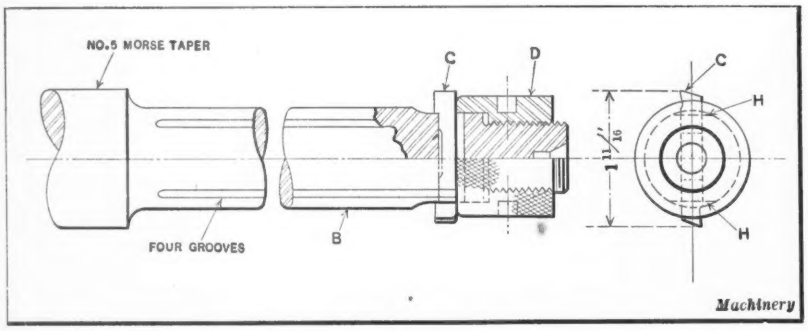


Fig. 1. Boring-bar used in boring Piston-pin Hole in Connecting-rods

CONNECTING-ROD BORING-BARS

Two boring-bars used for boring the small and large bearing holes in Fiat automobile engine connecting-rods are shown in Figs. 1 and 2. These boring-bars are of the inserted-blade type, and are provided with cutter-locking features of an unusual type. In performing the boring operations, the connecting-rod is held in a horizontal position in a heavy jig. This jig is first placed on the table of a drilling machine, where the small end of the connecting-rod is drilled, bored with the boring-bar shown in Fig. 1, and reamed to fit the piston-pin. After finish-boring and reaming the piston-pin hole, the jig with the connecting-rod still in place is transferred to another drilling machine where the large, or crankshaft bearing, hole is drilled, bored with the boring-bar shown in Fig. 2, and then reamed to size.

The small boring-bar shown in Fig. 1 is made of a solid bar with the end tapered to fit the taper in the spindle of the drilling machine. A bearing *B* is ground to fit a bushing in the jig which serves to guide and support the tool. At the end of this bearing is the inserted cutter *C*, which is held in a rectangular hole in the bar. The cutter is notched to fit the dimension across flats *H*, milled in the bar at each end of the rectangular hole. This arrangement enables the cutter to be accurately located and held in place by nut *D*. Nut *D* has right-hand threads, so that any chatter of the tool will only screw the nut up tighter.

The larger bar shown in Fig. 2 is provided with a front pilot *C* which insures greater rigidity. Small cutter blades *E* inserted in holder *F* are employed, as solid cutters would be too expensive. In this design the clamping nut *A* is placed behind the cutter. Left-hand threads are used in order to keep the cutters or cutter-block tight. The inserted piece *F* is located in the rectangular hole, and has flats at *H*. The two cutter blades *E* are held securely in the slots in *F* by means of taper pins *D*. Pins *B* serve to locate and take the thrust of cutters *E*. The boring-bars described are not expensive to make and can be kept supplied with fresh cutter blades at a small cost.

Irvington, N. J. C. H. Dengler

FORGING LEAD MODELS FOR PRACTICE

Lead has proved to be an excellent metal for use in teaching forging practice. It requires no heating, and small models of various tools or articles can be readily forged or formed to the desired shape while cold. This is an advantage in schools or colleges when a considerable number of students are under instruction and the equipment is limited. Models for lathe and planer tools, for instance, may be formed from pieces of lead about 4 inches long, and 3/8 inch thick, by 3/4 inch wide, or 1/4 inch thick by 1/2 inch wide.

New Britain, Conn. William C. Betz

MEASURING DISTANCE BETWEEN CENTER-PUNCH MARKS

The device illustrated is designed for accurately spacing center-punch marks when laying out work, and for measuring or checking the distance between center marks already made in the work. The main body *A* is made of machine or tool steel, the latter being preferable. The micrometer head support *B* and the stop support *C* are made of machine steel. The measuring or marking centers *D* and *E* are made of tool steel, and are hardened and ground to a conical point having a 60-degree angle. The head support *B* should be a good sliding fit in the elongated slot in body *A*, and no up-and-down or sidewise play should be allowed. The stop support *C* is stationary in the main body, and is provided with an adjustable stop-screw *F*, which is locked in place by screw *G*. Center *D* moves with the micrometer head support *B* into which it is screwed.

Center *E* should have no play in any of the equally spaced holes in which it is inserted. The holes for center *E* are spaced exactly one inch apart, and the number of holes depends on the purpose for which the device is to be used. In this particular case centers *D* and *E* can be brought to within 2 inches of each other. In making a device of this kind, it is best to machine and assemble all the parts before boring the holes for center *E*. By bringing the spindle of the micrometer head up against the stop, it is a simple matter to locate the first hole for center *E* at a distance of 2 inches from center *D*. The positions of the succeeding holes may then be laid out and accurately machined—preferably in a milling machine.

In using this device for measuring the distance between any two center marks, it is only necessary to move center *E* to the proper hole in body *A*, and adjust the micrometer head support which carries center *D* until both points or centers are located in the punch-marks. Next

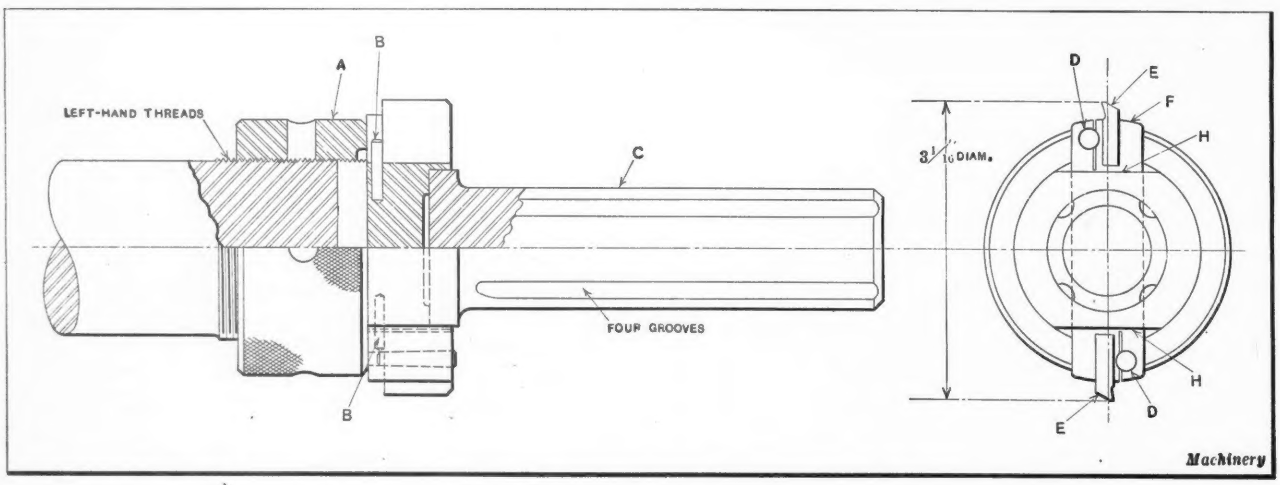
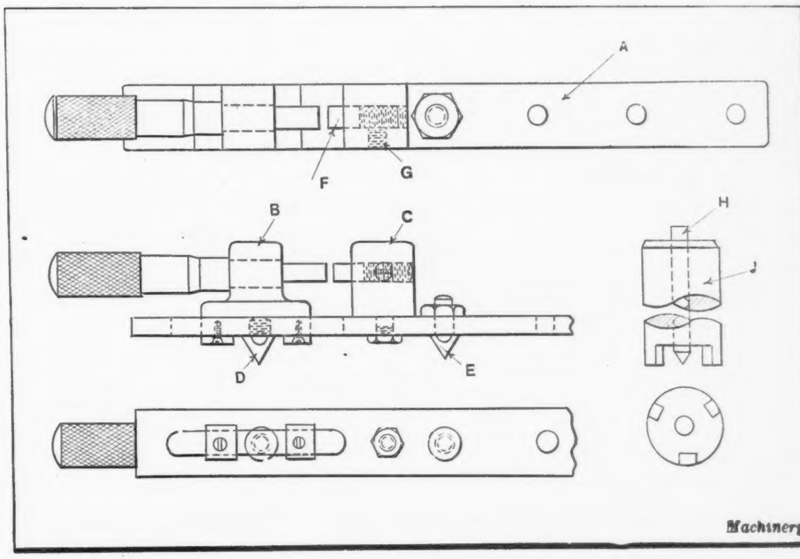


Fig. 2. Boring-bar for boring Crankshaft Hole in Connecting-rods

turn the micrometer head up until the spindle strikes stop F and take the micrometer reading, which will enable the distance between the center-punch marks to be accurately determined.

To lay out dimensions, centers D and E are moved to the correct positions, and a light hammer blow is given to the device above each of the centers in order to make slight impressions in the work, which may be enlarged by using the center-punch and holder shown in the lower right-hand corner of the illustration. Referring to this view, punch H is a piece of hardened drill rod ground to a conical point having an angle of 60 degrees. This punch is a sliding fit in block J which holds it in a vertical position when delivering the hammer blow.



Device for measuring Distance between Center-punch Marks

If the distance between the center-punch marks is found to be incorrect, one of the punch marks can be shifted by using an ordinary center-punch held at an angle with the face of the work. After the center mark has been moved in this way, the punch shown can be used to straighten up the center before again measuring the distance between the marks. This measuring device has proved very handy for laying out work on jigs, fixtures, and dies and it is also very dependable for measuring lengths. The writer has found that spacings aggregating many feet show a variation of but a few thousandths inch in total length when this device is used.

Ilion, N. Y. D. R. GALLAGHER

RELIEVING WORN TWIST DRILLS

Twist drills that have the lands worn down until there is insufficient relief back of the cutting edges of the flutes, or drills that have been ground down for special work, may be put into serviceable condition by regrinding in the following manner. The drill should first be trued up in the chuck of a cylindrical grinder, after which the periphery should be ground to clean up all worn portions and bring the drill down to a size, or diameter, that is commonly employed in the shop. In performing this grinding operation, care must be taken to back-taper the drill from 0.003 to 0.006 inch per foot, the amount depending on the size of the drill. This grinding should be done with a hard and comparatively fine-grained wheel. On small machines a No. 60 J alundum wheel has been found to give good results. As the cut is intermittent, on account of the flutes, and as no support is provided on the outer or cutting end of the drill, the depth of cut or feed should be light.

The drill is next placed in the V-block fixture shown in Fig. 1. This V-block and an additional block for supporting the shank of the drill are then placed on the magnetic chuck of the surface grinder in an angular position relative to the wheel, as shown in Fig. 2. After locating in this position, the drill is drawn past or under the grinding wheel, the V-block being set at an angle of about 20 degrees from the center line of the grinding machine spindle. The spring-plunger finger A, Fig. 1, guides the drill as it is pushed or drawn past the wheel, imparting a rotary or spiral motion to it. The plunger is left soft to prevent roughing or scratching the cutting edge of the drill flute. The platen of the machine, of course, remains stationary while the drill is being fed back and forth past the grinding wheel.

The amount of clearance can be regulated by adjusting the platen in relation to the wheel. In passing the drill through the V-blocks, a rotary motion is given to the work, which results in a clean-cut spiral relief back of the cutting edge of the flute. The width or amount of land may be regulated to suit the conditions of service. For the relieving operation, a No. 46 I Norton wheel is satisfactory.

New Britain, Conn. WILLIAM C. BETZ

* * *

INDUSTRIAL CONDITIONS IN RUSSIA

An almost inconceivable slump in Russian industries is indicated by the following figures compiled by the Department of Commerce from various reliable sources, showing the production of different industrial products during 1920, as compared with the production of the same products in Russia annually previous to the war: Pig iron, 2 per cent; copper ore, 0.6 per cent; rubber industry, 5 per cent; sugar industry, 5 per cent; cotton industry, 3 per cent; woolen industry, 4 per cent; coal production, 20 per cent. An average for all industries indicates that the production was less than 10 per cent of the pre-war production. The number of railway cars in running order is about one-half the number in use previous to the war. The road-beds are reported in very bad condition, and if extensive repairs are not made within the next few months, some sections of the railroads will have to be entirely closed to traffic. According to the latest estimate, at least 25,000,000 ties must be replaced. A considerable mileage of branch lines has been removed, the material being used for repairs on the main lines.

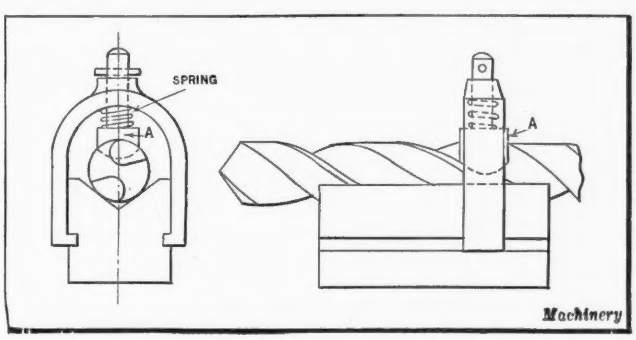


Fig. 1. V-block provided with Spiraling Device

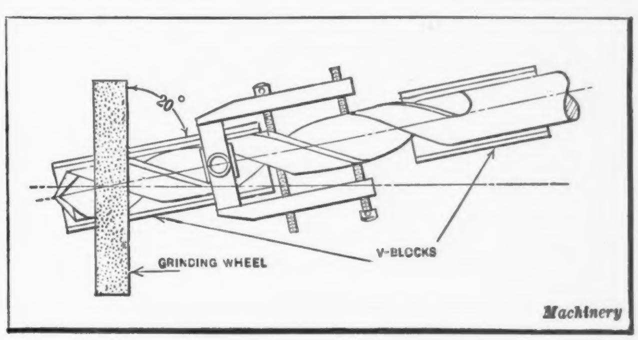
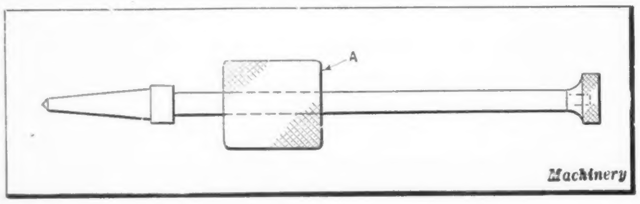


Fig. 2. Set-up for relieving Twist Drills

SHOP AND DRAFTING-ROOM KINKS

PRICK-PUNCH FOR ACCURATE WORK

The illustration shows a prick-punch having a long shank upon which a weight *A* may readily be slid. When desiring to produce a mark on a piece of work, the punch shank is held perpendicular to the work, after which the weight is



Prick-punch provided with Weight to facilitate the Marking of Work

lifted and allowed to drop on the shoulder of the punch. This tool is especially useful in laying out fine work, it being possible to produce a punch mark in much less time than with an ordinary punch and hammer. A small knurled head is attached to the upper end of the shank to prevent removal of the weight from the tool.

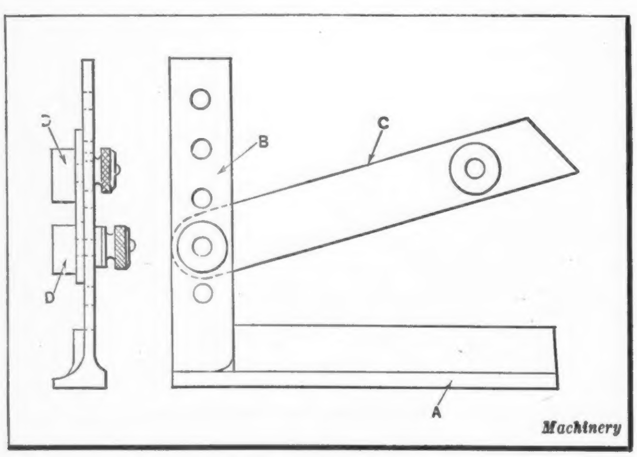
Rosemount, Montreal, Canada — STANLEY ALMOND

SINE-BAR TAPER GAGE

In turning or grinding tapers, it often happens that no suitable gage is available, and the only recourse is to gage the piece being ground by inserting it in the machine spindle or part in which it is to be used. The sine-bar taper gage shown in the accompanying illustration is designed to facilitate the gaging of the taper when performing this class of work. The simplicity of the design permits this device to be made by any skilled mechanic. The base *A* should be square with the sides and outer edge of the vertical blade section *B*. The holes in the blade must be accurately located from the bottom of the base or beam *A* and at an even distance from the outer edge of the blade. The adjustable blade *C* should be ground square, and so that its sides are parallel. The two holes for buttons *D* must be the same distance from one edge and have a given center distance, which in the case of the gage shown is 3 inches.

The procedure in setting the tool is practically the same as for a regular sine bar. It will be noted that the bottom of the beam projects the same distance as the buttons, so that micrometers may be used for setting. With this device, tapers and angles within the range of the instrument can be accurately measured.

New Britain, Conn. — WILLIAM C. BETZ



Sine-bar Taper Gage

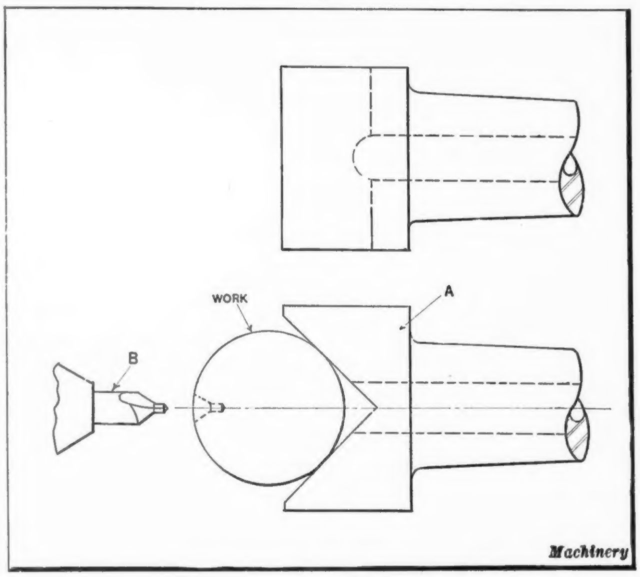
ENLARGING A REAMED HOLE

It sometimes happens that a hole is to be produced in a piece a few thousandths inch larger than the reamer will normally cut. This may be done by placing wires in two adjacent flutes of the reamer so that one side of the reamer rides on the wires, which should not project over 0.002 inch beyond the cutting edges.

New Britain, Conn. — WILLIAM C. BETZ

VEE FOR LATHE TAILSTOCK

The lathe tailstock vee shown at *A* in the accompanying illustration is intended for use in drilling small holes through round stock or such small parts as wrench handles, etc. The taper shank fits the hole in the tailstock, and has a hole drilled through the center as indicated. By placing the work in the vee as shown, then employing a center drill



Vee used in drilling Round Stock

B, and afterward the size drill required, a hole can be drilled through the work that will be accurately centered.

Ontario, Cal. — J. HOMEWOOD

RENEWING WORN CORNERS OF DRAFTING-BOARD

The following method can be used to prevent the surface of a drawing-board from being damaged by the insertion of thumb-tacks. With a wood bit about 3/4 inch in diameter, bore holes through the board near the corners where the thumb-tacks are to be inserted. Carefully measure the diameter of the hole in the board (as all bits do not bore to size) and have a hole drilled in a piece of iron plate the size of the hole in the board. Next, obtain a piece of white pine, poplar or similar wood, shave it down almost to size, and drive it through the hole drilled in the iron plate. Then, using a miter box, cut this piece into sections equal in length to the thickness of the board. Drive four of these sections or pieces into the holes in the drawing-board so that their ends will be flush with the upper surface of the board. When these pieces have become worn, it is a simple matter to reverse them in the board or insert new ones. For some work such as free-hand drawing, an ordinary cork can be used in place of the wooden plugs.

Fort Wayne, Ind. — NELSON HALL

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

STANDARDS FOR COMPOSITION GEARING

W. E. G.—Have any standards been adopted for rawhide and other non-metallic gearing?

A.—Standards for composition gearing were adopted by the American Gear Manufacturers Association in 1919. An abstract of the specifications adopted was published in MACHINERY, January, 1920, page 476.

FORMING DIE PROBLEM

ANSWERED BY J. F. THORNTON, CINCINNATI, OHIO

The following method of forming a shell of the shape shown at *A*, Fig. 1, is proposed as a solution for the problem submitted by R. A. B. in April MACHINERY, page 792. The writer wishes to state that the extrusion-by-oil principle incorporated in the method to be described has proved practical for the production of similarly shaped shells of lighter material. Some experimental work, however, is necessary to obtain satisfactory results. In the problem as submitted some of the work had already been performed on the shell, and for such partially completed work the writer can offer no solution. However, it is assumed that it is not necessary to carry out the forming operations in any particular order. In producing the shell the writer would first form a straight tube having an inside diameter of 1 1/16 inches as shown at *A*, Fig. 2. The length of this tube can best be determined by experiment. After forming the straight tube, the open end should be curled in to the shape shown at *B*.

The extruding operation, which completes the forming of the shell, should be performed in a split die consisting of two members *C* and *D*, Fig. 1. One half *D* of the die is hinged, which permits the die to open on center line *X-X*. After filling the closed-in shell with an oil of low compressibility, it is inserted in the extruding die. In descending, the plunger *E* first effectually closes the vent *F*, and then as it continues on its downward stroke it compresses the oil so that it will flow to the points of least resistance as indicated by the arrows. This action forces the metal into the crevices of the die, thus giving the shell the desired form.

The writer would make the capacity of the first trial tube, as shown at *B*, Fig. 2, about 1¼ times the capacity of the finished piece. If the cubical contents of this shell are too great, the plunger cannot be forced deep enough, and if the capacity of the shell is too small, the corners of the shell will not be square. A number of small vent holes, as shown in Fig. 1, should be drilled in the hinged die member *D* to release the air which would otherwise be trapped in the corners of the die. These holes must be small or the metal will be extruded at the points where they enter the die cavity.

Some slight difficulty may be encountered in preventing the spherical form at the top of the tube shown at *B*, Fig. 2, from becoming wrinkled. It should be borne in mind that the smaller the hole at the top of the spherical end of the tube, the better will be the results obtained in the final forming operation. As a last resort, hole *F* might be closed by soldering after the tube has been filled with oil. After the last forming operation, the holes at the top and bottom of the shell may be finished by drilling.

INTERNATIONAL PATENT PROTECTION

H. A. F.—Is there such a thing as an "international patent," that is, some kind of patent that, under an agreement between various countries, will protect an inventor in a number of countries by the making of a single application? In that case, does such a patent protect a foreign inventor in the United States for a given time, and if so, for how long?

A.—There is no such thing as an international patent. Under the International Convention for the Protection of Industrial Property, inventors may file applications in the countries that have agreed to this convention at any time within twelve months from the filing of the application on which a patent would be issued in any one of the countries; but in order to obtain patent protection in the different countries, separate applications must be filed in each.

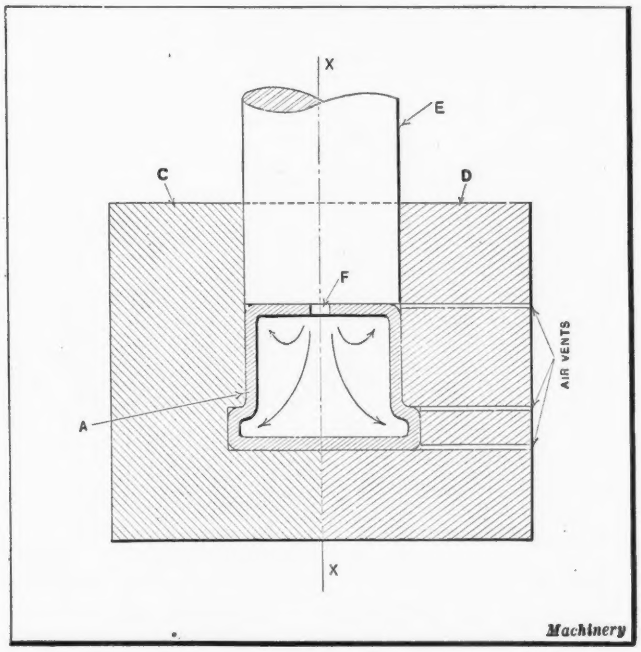


Fig. 1. Sectional View of "Oil Extrusion" Die for Final Forming Operation on Shell A

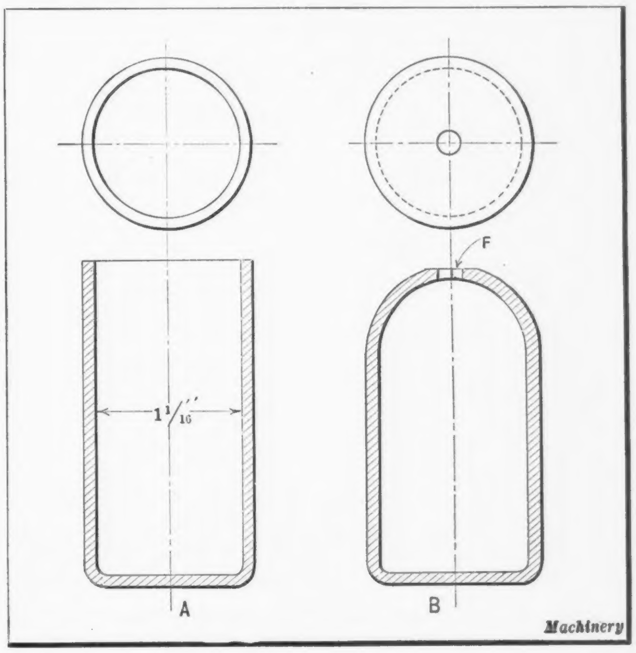


Fig. 2. Shell after First and Second Operations preparatory to forming in Die shown in Fig. 1

PROBLEM IN GAGE DESIGN

H. A. B.—In designing the gage shown in Fig. 1, a mathematical problem is involved which requires the solution of angle β. How can the magnitude of this angle be found?

ANSWERED BY W. W. JOHNSON, CLEVELAND, OHIO

A.—With the values for a, b, h, and r given in Fig. 1, the magnitude of angle β can be calculated as follows (see Fig. 2):

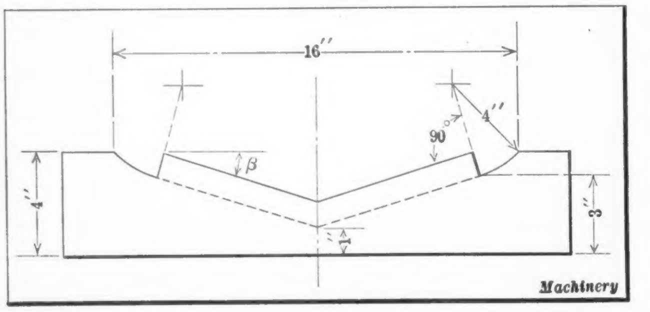


Fig. 1. Gage having Angular Surface, involving Mathematical Calculations

$$z = h \cot \beta; \text{ also } z - x = r \sin \beta$$

Then

$$x = h \cot \beta - r \sin \beta \quad (1) \qquad y = h + r \cos \beta \quad (2)$$

$$r^2 = (y - a)^2 + (b - x)^2 \quad (3)$$

Substituting (1) and (2) in (3),

$$r^2 = (h + r \cos \beta - a)^2 + (b + r \sin \beta - h \cot \beta)^2$$

Expanding and combining,

$$(a - h)^2 + b^2 - 2ar \cos \beta + 2br \sin \beta - 2bh \cot \beta + h^2 \cot^2 \beta = 0$$

But

$$\sqrt{1 - \sin^2\beta} = \cos \beta \text{ and } \frac{\sqrt{1 - \sin^2\beta}}{\sin \beta} = \cot \beta$$

Then

$$(a - h)^2 + b^2 - 2ar\sqrt{1 - \sin^2\beta} + 2br \sin \beta - \frac{2bh\sqrt{1 - \sin^2\beta}}{\sin \beta} + \frac{h^2(1 - \sin^2\beta)}{\sin^2\beta} = 0$$

Clearing of fractions, factoring, and transposing,

$$(a^2 + b^2 - 2ah) \sin^2\beta + 2br \sin^3\beta + h^2 = 2 \sin \beta \times (ar \sin \beta + bh) \sqrt{1 - \sin^2\beta}$$

Squaring both sides of the equation, combining, and arranging terms with reference to sin β, we get

$$4r^2(a^2 + b^2) \sin^6\beta + 4br(a^2 + b^2) \sin^5\beta + [(a^2 + b^2 - 2ah)^2 + 4(b^2h^2 - a^2r^2)] \sin^4\beta - 4bhr(2a - h) \sin^3\beta + 2h^2(a^2 - b^2 - 2ah) \sin^2\beta + h^4 = 0 \quad (4)$$

Substituting the known values in Equation (4) we obtain

$$4672 \sin^6\beta + 9344 \sin^5\beta + 4169 \sin^4\beta - 1024 \sin^3\beta - 536 \sin^2\beta + 16 = 0$$

Solving this equation by Horner's method, we find Sin β = 0.3000244, and angle β = 17 deg. 27 min. 33 sec.

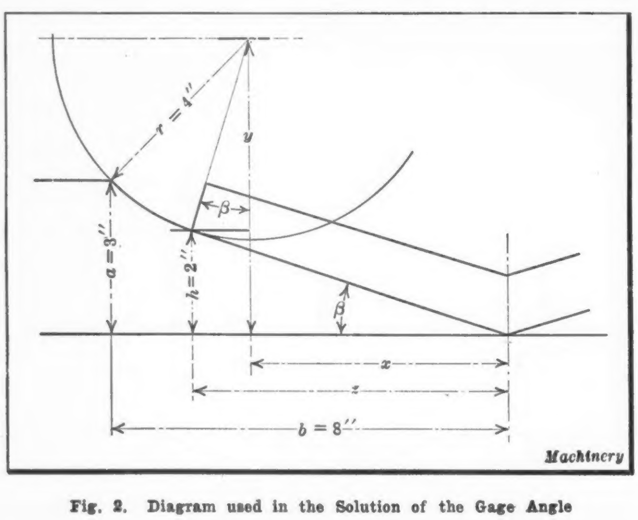


Fig. 2. Diagram used in the Solution of the Gage Angle

COST OF CYLINDER REGRINDING EQUIPMENT

H. E. W.—Will you please tell me what equipment is required for handling a small gas engine cylinder regrinding business and what would be the approximate initial expenditure?

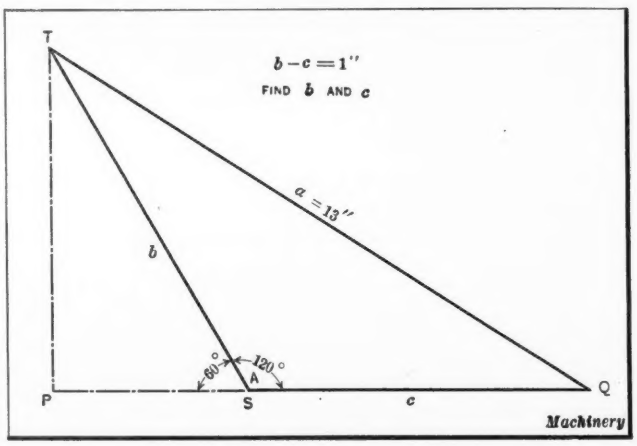
A.—It would be necessary to have a fully equipped bore-grinder, costing about $2500 when new; a small lathe which can be bought for about $200; a drilling machine costing about $125; a supply of over-size pistons costing $2.60 each, say half a dozen sizes in sets of four, representing $62.40; piston-rings for the pistons at 30 cents a piece, $7.20; wrist-pins, $15; small tools, not over $100; making a total of slightly over $3000. If a small cylindrical grinder for external work is included (or a grinding attachment for the lathe), over-size pistons could be ground to size from the semi-finished state and their cost correspondingly lowered, resulting in ultimate economy.

DETERMINING THE LENGTHS OF TWO SIDES OF AN OBLIQUE TRIANGLE

H. W. P.—The accompanying illustration shows an oblique triangle in which the difference between the lengths of sides b and c = 1 inch; the length of side a = 13 inches; and angle A = 120 degrees. How can the lengths of sides b and c be found?

ANSWERED BY C. N. PICKWORTH, MANCHESTER, ENGLAND

In the following is given a solution to this problem which is believed by the writer to be simpler and more direct than that presented on page 580 of February MACHINERY. Referring to the accompanying illustration, continue QS to



Oblique Triangle of which the Lengths of Sides b and c are to be found

P and draw TP at right angles to PQ. It will be obvious that angle TSP = 60 degrees. Then, $PS = \frac{1}{2}\ ST$ and $PT = \sqrt{3} \times \frac{1}{2}\ ST$. Also, if $b - c = 1$, $b = c + 1$. Therefore,

$$QP = c + \frac{c + 1}{2} \text{ and } PT = \sqrt{3} \times \frac{c + 1}{2}$$

Hence

$$\left(c + \frac{c + 1}{2}\right)^2 + \left(\sqrt{3} \times \frac{c + 1}{2}\right)^2 = 13^2 = 169$$

$$\frac{9c^2 + 6c + 1}{4} + \frac{3c^2 + 6c + 3}{4} = \frac{12c^2 + 12c + 4}{4} = 169$$

$$3c^2 + 3c + 1 = 169$$

$$3c^2 + 3c = 168$$

$$c^2 + c = 56$$

Then

$$c^2 + c + 0.25 = 56.25$$

$$c + 0.5 = 7.5$$

and

$$c = 7.5 - 0.5 = 7 \text{ inches}$$

Finally, as

$$b = c + 1$$

$$b = 7 + 1 = 8 \text{ inches}$$

DUPLEX MULTI-SPINDLE TURRET MACHINE

The machine shown in the accompanying illustrations, which is built by the Blomquist-Eck Machine Co., Cleveland, Ohio, is intended for work that is to be machined from both ends simultaneously and on which a number of turning, boring, facing, drilling, and threading operations have to be performed. The machine is entirely automatic, except that it is loaded and unloaded by the operator. It consists mainly of a revolving turret for holding the work and six work-spindles operating upon the work, three from each side, two of these being roughing spindles, two finishing spindles, and two drilling and threading spindles. The turret has eight flat faces, each with a groove in the center to receive the tongue of the work-holding fixture. While the work is being performed, the turret and the work being actuated upon remain stationary and the spindles holding the cutting tools rotate. These spindles are fed in to the work automatically by means of cams, after which they return rapidly to the outward position, when the work-holding turret is automatically unlocked, the index-plunger released, and the turret automatically indexed to the next station, at which time the index-plunger drops into the next index-hole in the turret. The turret is then automatically locked, after which the same cycle is repeated.

The machine is motor-driven. Power is transmitted from the motor to a jack-shaft at the rear of the machine by means of a chain drive, and from the jack-shaft another chain drive transmits power to the finishing spindles; from these, in turn, power is transmitted by a chain drive to the roughing spindles. There is also a separate chain drive from the jack-shaft to the die-head and drilling spindles. These chain drives are duplicated at each end of the machine.

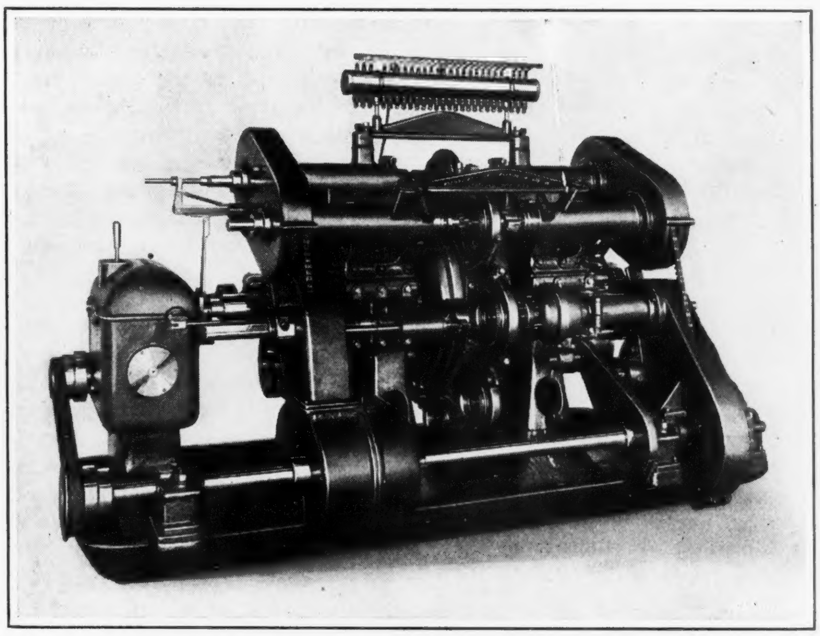


Fig. 2. Rear View of Blomquist-Eck Duplex Multi-spindle Turret Machine

The feed to the spindles is actuated from the jack-shaft through a gear-box. The drive from the jack-shaft to the gear-box is by a belt on a three-step cone pulley, from which the motion is transmitted by a pair of helical gears, and a worm and worm-wheel to a shaft geared to the shafts on which the cams are mounted. The indexing is also controlled by the mechanism in the gear-box, which is so arranged that the feed motion is temporarily disengaged while the indexing takes place. At the front of the gear-box a crank is provided for hand adjustment and for setting the spindles when setting up the machine. The gear-box runs in a bath of oil. The sub-base and pan of the machine are cast hollow and act as a reservoir for holding the oil, a pump being provided for the circulation of the lubricant.

The main advantage of the machine is its capacity for

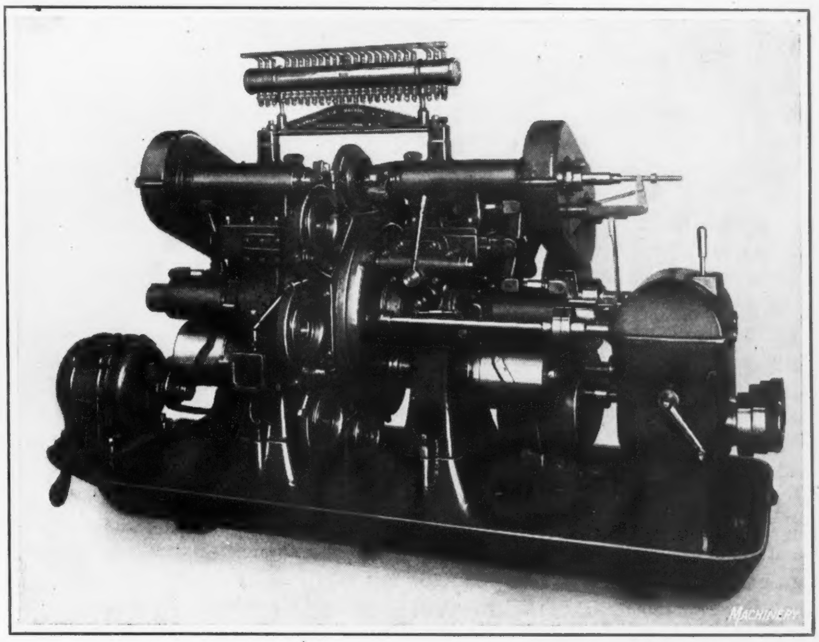


Fig. 1. Duplex Multi-spindle Turret Machine made by the Blomquist-Eck Machine Co.

machining pieces from both ends at one setting, assuring on the one hand concentricity and accuracy in the product, and on the other, increased production because of the reduced amount of handling. The machine was originally designed for the machining of Studebaker automobile front and rear stamped steel hubs, of which a production of 520 hubs in ten hours was obtained.

The large production required in the automobile field has paved the way for special automatic machinery of the type described. The necessity for reducing manufacturing costs to meet present prices in the automobile field makes the need for labor saving machinery all the more urgent.

* * *

LABOR AND READJUSTMENT

Large classes of labor have taken their losses by severe wage cuts. Among those that have accepted them have been many skilled crafts which have seen that in the long run wages on the new basis will have a purchasing power equivalent to that when wages were higher.

Certain classes of labor contrast unfavorably, however, with labor as a whole. The time is not far distant when not only that uncertain group known as the "general public" but those sections of it consisting of other classes of workers and farmers will have come to a realization that labor pays its own wages, which are ultimately measured, not in money, but in goods. The money wage only measures the estimated worth to other consumers of the goods produced by the wage earner. When any class of labor attempts to force its wages out of line with other wages and the price level, that group endeavors primarily to take advantage, not of capital, but of other workers, who must suffer as others gain.—*National Bank of Commerce*

The Metal-working Industries

NOTWITHSTANDING present conditions in the machine tool industry, which, regarded by themselves would offer but little encouragement to those engaged in this basic field, it is not impossible, in surveying the entire metal-working field, to share the belief that a change for the better is in sight. It is natural that the machine tool industry should be in a state of depression when the iron and steel industry as a whole is declining or remaining stationary at a point of low activity. But when iron and steel show definite signs of renewed activity, there is every reason to believe that a demand for machine tools will make itself felt within a reasonable time. It has been aptly said that "the only use for machine tools is to cut up iron and steel," and unless there is some iron and steel to be cut up, there can be no demand for machine tools.

Everyone engaged directly or indirectly in the machine tool field should therefore note that all reports from the iron and steel industry confirm a continued improvement in orders, operation, and inquiries. There is slow but steady improvement in the entire iron and steel trade, from pig iron to finished products. The United States Steel Corporation, as a whole, is operating at about 35 per cent capacity, as against 25 per cent a few weeks ago, and the operation for the entire industry is placed at about 40 per cent, with 50 per cent in sight. Tin plate mills are working at considerably more than 50 per cent, and sheet mills at nearly 85 per cent of their capacity. As a consequence, prices of sheet steel have advanced $5 a ton, and prices on bars, shapes, and plates have been advanced by some companies from $1 to $3 a ton. The demand for pipe and wire is also stronger, and the market for structural materials is more active.

General Conditions in the Machine-building Field

Another indication of a slow but definite improvement in the metal-working industries is reported from the small tool manufacturers, who, in general, found the lowest point of their business reached in June or July, with a gradual gain since that time. Isolated cases of great activity in the machine-building field may also be mentioned. One large Pennsylvania engine builder operates day and night in the building of steam shovels for construction work, and another large Pennsylvania shop keeps its plant occupied on nail-making machinery. In the northern Ohio district, in and adjacent to Akron, the tire mold business shows activity. In the gear-cutting field, where the depression was felt much later than in the machine tool field, there has been considerable reduction in activity, and many plants are running at greatly reduced capacity; yet in the case of manufacturers engaged in cutting automobile service gears, very active business is reported, one manufacturer, at least, running two shifts.

Some of the gray iron foundries are running full time with full force, but prices on castings have been reduced to such a point that practically all profit has been wiped out and just the bare costs are covered. In many lines of machine tools, so substantial have been the reductions that further price cuts cannot be expected.

The Railroad Situation

Most manufacturers of medium and heavy machine tools, as well as dealers handling these lines, agree that unless the railroads are in a position to buy within the near future, there is no immediate prospect for any considerable business in this class of machines. At the present writing, just when the constantly increasing operating income of the railroads might have placed them in a position to rehabilitate their shop equipment and rolling stock, comes the threat of a nation-wide railroad strike against accepting the 12 per cent wage reduction which became effective July 1. It is most unfortunate that at the very moment when the railroads were in a position to buy shop equipment, the unions should deal them another blow from which it may take them a long time to recover.

The net railway operating income in August amounted to over $85,000,000, contrasted with the deficit of $150,000,000 in the same month a year ago; and this in the face of the fact that the railroads will pay labor in 1921, on the basis of the wages paid in the first six months of the year, $1,175,000,000 more than in 1917. Furthermore, the railroads have been seriously contemplating the reduction of freight rates, and in some instances such reductions have already taken place. All these steps toward more favorable industrial conditions may now be frustrated by the action of the railroad unions. It has been estimated that $1,600,000,000 is needed to bring the railroads of the country back to the standard of 1911. If the railroads continue to pay excessive wages, there will be nothing left for necessary improvements and equipment, and sooner or later they will have to pass into receiverships.

The Automobile Industry

The reports from different automobile manufacturers vary considerably. On the whole, automobile production is decreasing for the moment, this being the usual seasonal falling off, and the output in October is estimated to be 20 per cent less than during the previous month. Ford production, which has been at high tide for the last five months, each month breaking the record of the previous one, has dropped off from 10 to 15 per cent. On the other hand, there is an increasing demand for some of the higher priced cars, and the Cadillac and Packard plants are reported to be operating at a higher capacity than at any time during the past year. More Franklin cars were also shipped in September than during August, and in the trade this is interpreted as indicating that the purchasers of higher grade cars are convinced that industrially the country has now turned the corner. Another sign of increased activity is the report of the Motor and Accessory Manufacturers' Association, that purchases of parts have somewhat increased, and that there are fewer unpaid accounts and notes outstanding.

Labor Conditions

During the month of September, according to the statistics of the Department of Labor, there was an increase of 1.2 per cent in the number of men employed in the plants included in the Department's survey, the increases being mainly in the textile and iron and steel industry and in the railroad field. The influence of the labor unions in retarding the return of industrial activity by refusing to accept reasonable wage reductions is indicated in a statement by George E. Roberts of the National City Bank of New York, who says:

"One-half of our population is engaged in producing foodstuffs and raw materials, a considerable share of which must be exported and sold in world markets. These products have fallen almost to the pre-war level, while the products of urban industries, held up by labor costs and understandings of various kinds, have undergone comparatively slight reductions. The result is that the producers of the former goods can buy but one-half as much of the products of urban industries as formerly. There can be no revival of prosperity until a readjustment of these relations is accomplished."

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

Davis-Bournonville Tube Manufacturing Equipment

A COMPLETE line of equipment for the oxy-acetylene welding and fabricating of tubing for use in the construction of automobiles, bicycles, motorcycles, furniture, office appliances and machinery, in which strength combined with lightness is a prime requisite, has been developed by the Davis-Bournonville Co., Jersey City, N. J. This line includes gang-slitting, tube-forming, welding, straightening, seam-grinding, cutting-off, swaging and bending machines and draw-benches.

Manufacturing plants which are equipped with this line of machinery have the means for producing tubes of any common diameter and gage on short notice. Commercial steel sheets of any gage between Nos. 10 and 22 may be cut into strips, formed into tubes from 5/8 to 4 inches in diameter, and welded. Thus it is unnecessary to carry in stock tubes of many diameters and gages to meet anticipated uses, but instead, commercial sheets may be bought in the open market, as required, or sheet stock in few gages may be kept on hand ready for slitting, forming, welding and subsequent fabrication. It is generally found advantageous to purchase tube stock in strips trimmed to the required widths, as this practice results in comparatively little waste.

Slitting and Tube-forming Machines

When tubing is made from commercial sheets, slitting machines are required to cut the sheets into strips suitable for the forming operation. The lengths of tubing before drawing are limited to the length of the sheets used. If tubing is produced from strip stock, a slitter is not required unless it is necessary to trim the strips to width, in order to insure uniformity and smooth edges. A gang slitter is shown in Fig. 1. The shafts of this machine are made of alloy steel, ground and fitted with keys for the entire working length. Provision is made for simultaneous adjustment of the bearings, thus maintaining accurate alignment. The cutters are made from steel forgings, accurately ground, and are resharpened by face-grinding, which results in the original settings being maintained. The cutters are used in opposed pairs and are set up by means of wide and narrow ring spacers.

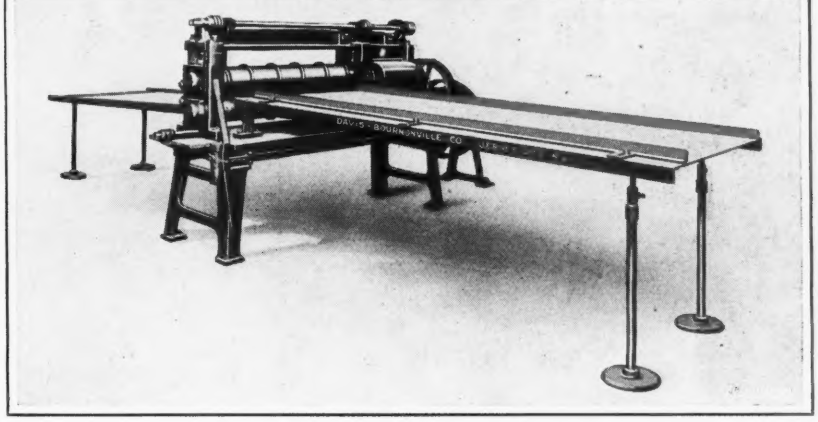


Fig. 1. Machine for slitting Commercial Steel Sheets, which is built by the Davis-Bournonville Co.

One end-bearing housing may be drawn off the shafts through the operation of a screw, and then swung out of position to permit the removal of cutters and spacers. The latter can be changed in a few minutes. Tables having a width equal to that of the widest sheet which can be accommodated by the machine are placed on each side of the cutters, the feed table being equipped with adjustable guides. The power is conveyed to the machine through a friction clutch, and the normal cutting speed is 50 feet per minute. Gang slitters are built by this company in various styles and sizes for cutting steel sheets ranging from 18 to 52 inches in width and up to No. 10 gage in thickness.

Tube stock, whether cut from mill sheets or supplied in rolled strips, must be form-rolled preparatory to welding. The Davis-Bournonville tube-forming mills are of the two- and three-roll stand types, the former being illustrated in Fig. 2. It comprises a break-down and finishing roll stand. The machine is operated by one man who handles both the strips and the formed tubes. A

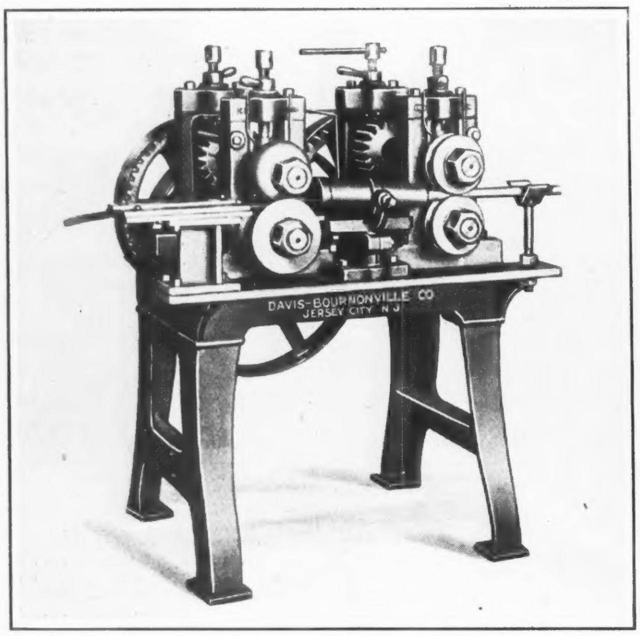


Fig. 2. Two-roll Stand Type of Tube-forming Mill

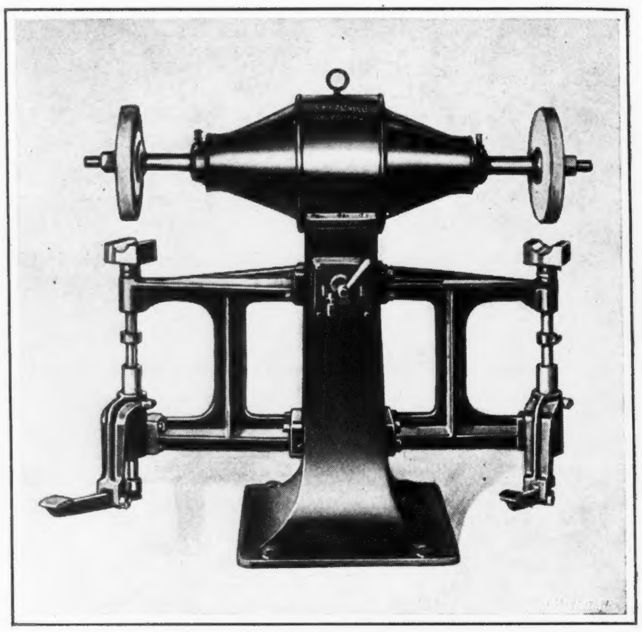


Fig. 3. Machine for grinding off Ridge produced in Welding

hollow conical conductor between the roll stands completes the forming started by the first pair of rolls, and the second pair compresses the formed tube into a truly circular shape. Adjustments of the tube-forming rolls may be made while the machine is in operation. The speeds are from 50 to 100 feet per minute, depending on the diameter and gage of the material being operated upon. The three-roll stand tube-forming mill is similar in construction and arrangement to the two-roll type, except that it is provided with an extra stand of rolls.

Tube-welding Machines

From the tube-forming machine the tubing goes to a welding machine and thence to an inspector's station at which unwelded spots are welded by means of hand torches. The No. 1 tube-welding machines illustrated in Fig. 4 are built for right- or left-hand operation, and with or without a motor drive and push-button control. The usual power equipment comprises a 230-volt adjustable-speed direct-current motor, field rheostat, magnetic control panel and push-botton station, with reverse. There are thirty-six different speeds, which is ample for all gages of metal and diameters of tubing within the capacity of the machine. The motor drives through a belt, and dynamic braking gives instant control. Starting, stopping, and reversing of the machine are effected without shock. The rolls are individually adjustable for alignment, and the guide rolls are adjustable relative to the welding rolls. The welding rolls are vertically adjustable to compensate for the stresses produced by the contraction of the cooling metal.

The welding torches used on these tube-welding machines are of the multiple-flame type, the number and arrangement of flames varying with the gage and diameter of the tubing, speed of welding, and kind of metal. The larger tips are

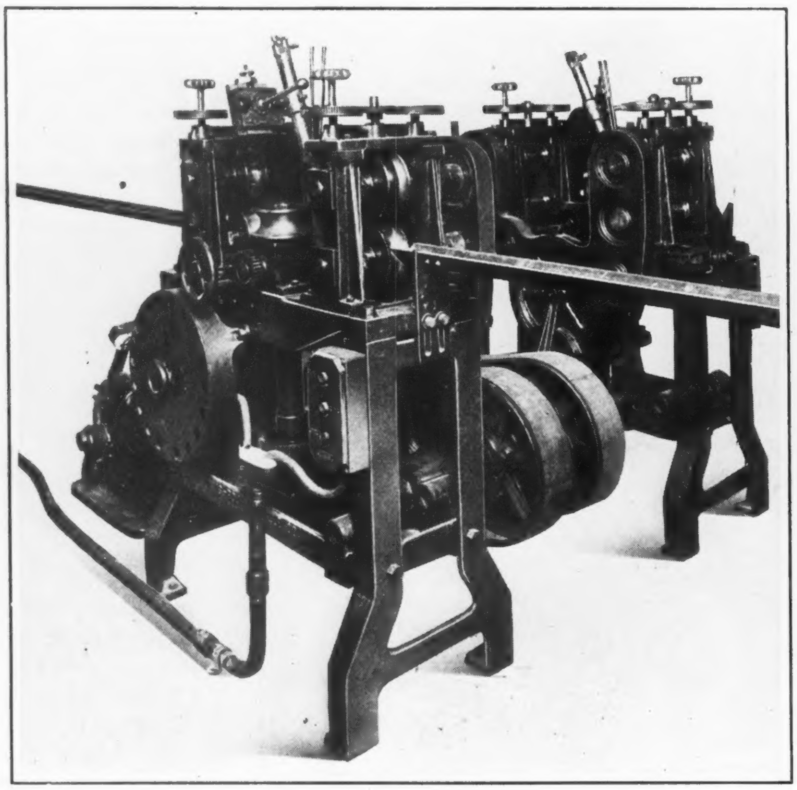


Fig. 4. Tube-welding Machines built for Right- or Left-hand Operation

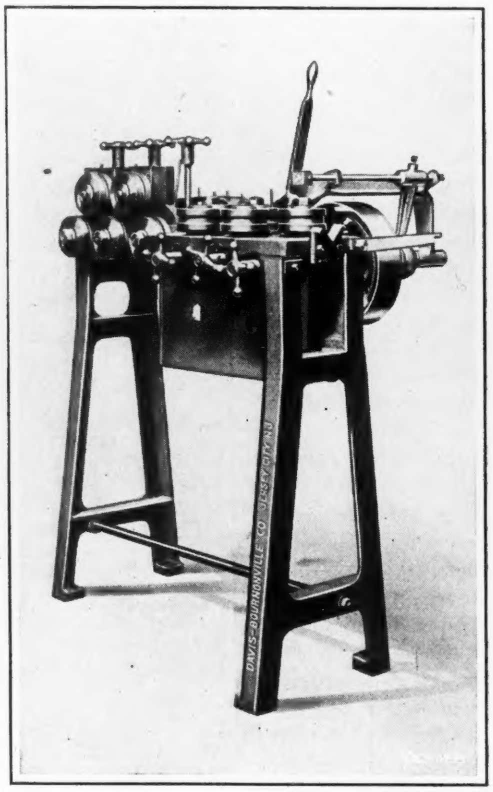


Fig. 5. Straightening Machine with Two Sets of Rolls

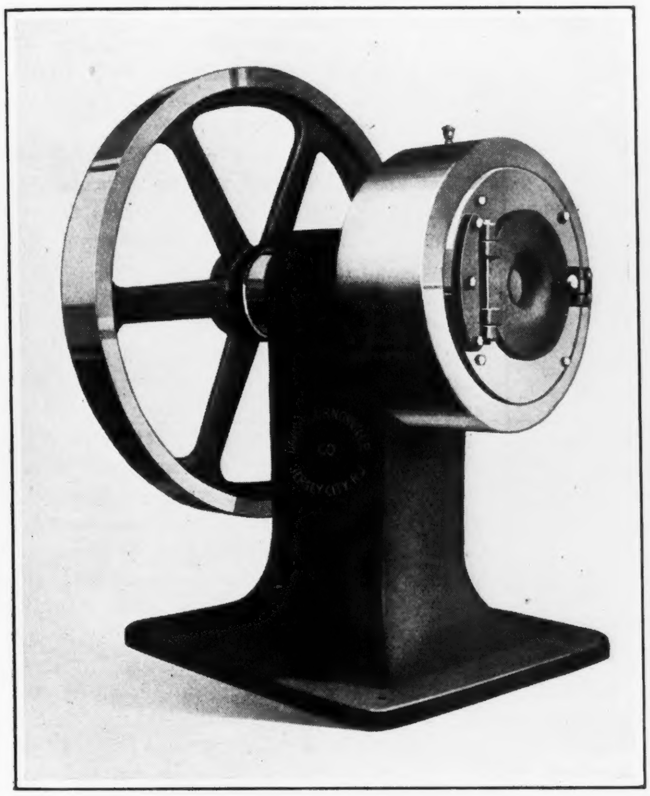


Fig. 6. Rotary Swaging Machine with Ten or More Rolls in the Head

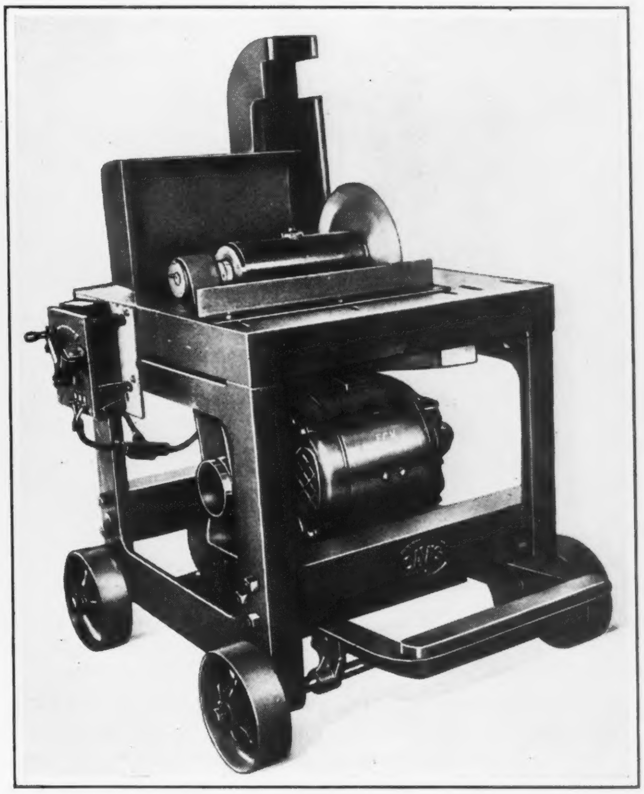


Fig. 7. Motor-driven Tube-cutting Machine having an Oscillating Head

water-cooled in order to maintain uniform heating conditions, the cooling water being circulated through the tip and then into the barrel of the torch. Rolls are furnished for any diameter of tube from 1/2 to 3 inches, inclusive, and the welding speeds vary between 36 and 72 inches per minute. Conductors are placed between the welding and finishing rolls for tubes 1 1/4 inches and smaller in diameter. A universal torch-adjusting arm is supplied with these machines when required.

An important feature of the No. 2 tube-welding machine is the overhung mounting of the rolls, which facilitates changes. This machine is supplied for right-hand operations only. A two-speed gear change in the base, together with an adjustable-speed motor, provides variations in welding speeds ranging from 24 to 168 inches per minute. The bearings subjected to heat are cooled by the circulation of water through cored spaces in the housings. Welding at the higher speeds is facilitated by the provision of two sets of following rolls. The No. 2 welding machine has a capacity for welding tubes ranging in size from 1 1/4 to 4 inches diameter, and up to No. 10 gage.

Straightening Machine

The next machine used in the process of tube manufacture is the straightening machine shown in Fig. 5. This machine is built in three sizes, all of which are of the ten-roll type having rolls arranged in two sets of five each, the axes of the rolls in one set being placed in a horizontal plane, while those of the other set are placed in a vertical plane. Three rolls of each set are power driven, and the last roll in each set is adjustable. The two idler rolls are mounted on studs attached to cross-slides provided with a screw adjustment. The No. 1 machine has a capacity for straightening tubes up to 1 inch in diameter; the No. 2 machine, up to 2 inches in diameter; and the No. 3 machine, from 1 1/2 to 3 inches in diameter.

Seam Grinding Machine

From the straightening machine, the tubes go to a seam-grinding machine for the removal of the slight ridge produced in the welding operation, or else they go to a draw-bench. When the tubes are finished by drawing, it is unnecessary to grind off the flash, as this is smoothed out in the drawing process. The grinding machine shown in Fig. 3 is designed to grind off the flash rapidly and to provide for uniform wear of the grinding wheels across the face. The tube passes under the wheel at an angle while supported in a formed rest elevated by foot pressure. The machine is driven by a 7 1/2-horsepower alternating-current ball bearing motor having a large-diameter armature shaft that extends at each end, on which the grinding wheels are mounted. The foot-control pressure mechanism and the tube guides are arranged to enable the grinding of tubes at any desired angle. As the wheel faces wear concave, the grinding of flat spots is obviated. The machine is so designed that two operators may work simultaneously, one on each end of the machine. The motor has an integral starting device and is of any standard voltage and frequency.

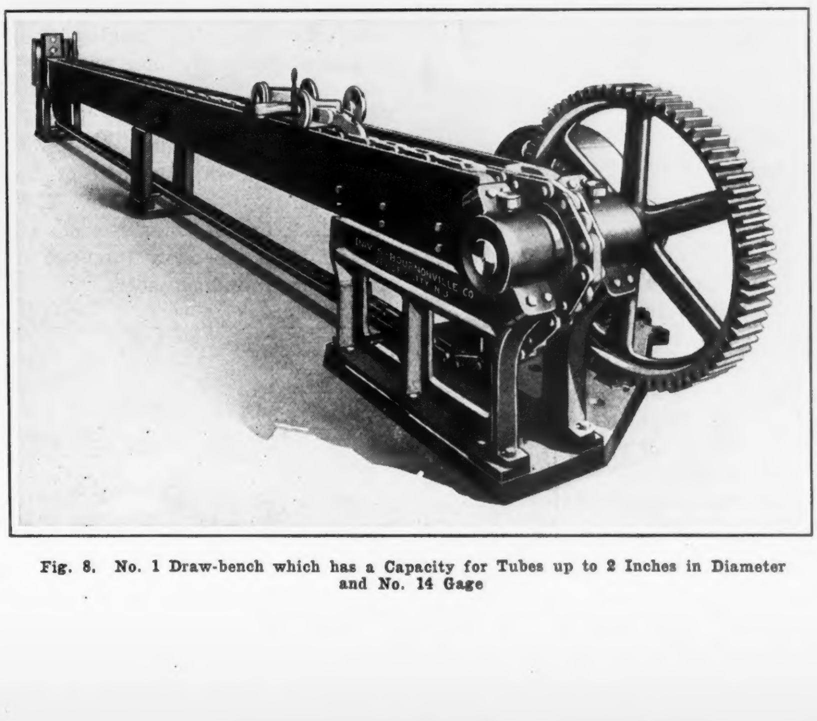


Fig. 8. No. 1 Draw-bench which has a Capacity for Tubes up to 2 Inches in Diameter and No. 14 Gage

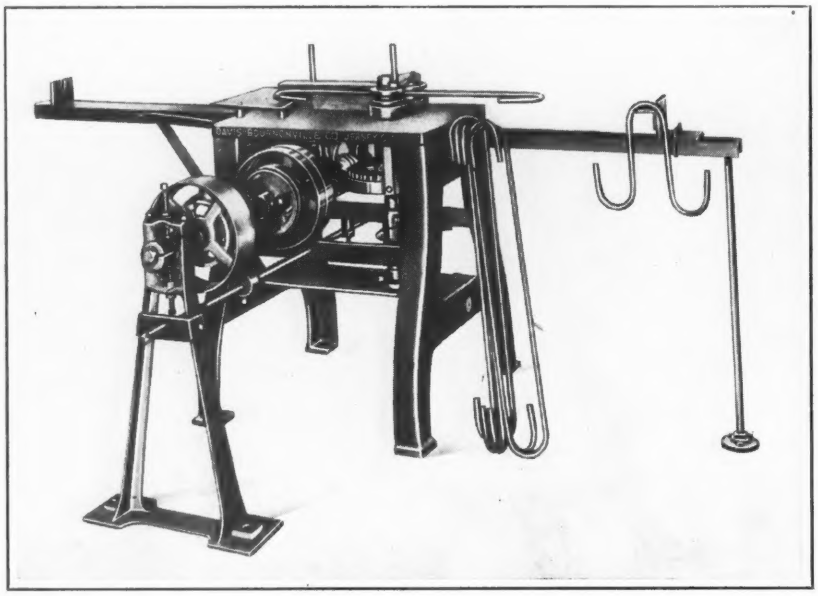


Fig. 9. One Style of Tube-bending Machine developed by the Davis-Bournonville Co.

equipped with back benches for drawing tubes over a plug or mandrel, when necessary. The driving clutch is operated through a shaft running the length of the bed and having a lever at the head of the bench.

Three regular styles of tube-bending machines are also made. The No. 1 machine illustrated in Fig. 9 has a maximum bending radius of 8 inches; the No. 2 machine, of 12 inches; and the No. 3, of 35 inches. A special No. 2 machine will bend to a radius of 25 inches, while a special No. 3 machine can also be built for bending to a larger radius than the regular type. The standard machines are equipped with double clutch pulleys for operation in either direction. The Nos. 2 and 3 machines are provided with power attachments and a back bench when required. The power attachments are made in various forms suited to the class of work to be done, and operate a rack to which is attached a plug that gives internal support when bending. The rack that controls the plug may be operated by power in either direction.

The main drive of the machines is through reduction gearing and a steel worm which drives a bronze worm-wheel, or a cast-iron worm-wheel provided with a bronze band for the teeth, the construction depending on the work for which the machine is employed. The oscillating tube carriage, carrying the roll, vise, and other parts, is mounted on the same shaft as the worm-wheel. The carriage is so designed as to enable tools for any diameter of tube and bending radius to be readily mounted in place. A stationary half-die furnished with the oscillating members is actuated by a cam, screw, or in conjunction with a follower.

The construction of the bending mechanism makes possible the bending of light-walled tubing without wrinkling or distortion. A dog directly beneath the worm-wheel, which operates on adjustable knock-outs, limits the angle to which a bend is made. These bending machines are suitable for bending tubes of all kinds of metal, of any shape, and to angles not exceeding 180 degrees. The operating levers are so located that a machine is readily controlled by one operator. The number of bends made per hour vary with the length, diameter, and angle, and is usually between 60 and 120.

Swaging and Cutting-off Machines

Tapered tubes and a great variety of shapes are produced by swaging. A swaging machine of the rotary type, using ten or more rolls in the head, and so designed and constructed that its operation is practically noiseless, is shown in Fig. 6. The dies have cam surfaces that engage the rollers easily, and produce a smooth acceleration. This machine is made in three sizes, each of which may be fitted with dies of different lengths, but the swaging is not limited by the length of the dies. Mechanical feeding devices are furnished when required, as well as equipment for special work. The roll cages and shafts are made from forgings machined all over, and the rolls, dies, and hammers are made from special alloy steel, hardened and heat-treated. The maximum die dimensions on the No. 1 machine are 1⅜ inches in diameter and 2¼ inches in length; on the No. 2 machine, 2 inches in diameter and 4 inches in length; and on the No. 3 machine, 3 inches in diameter and 5 inches in length.

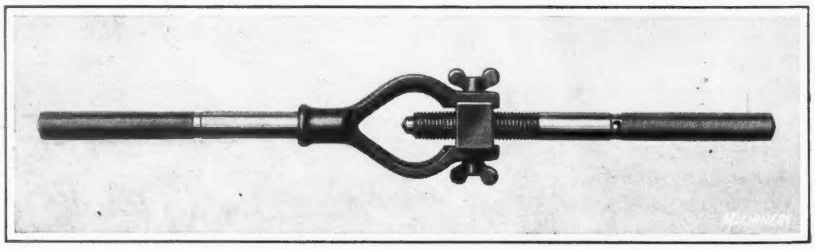
A motor-driven machine designed for the rapid cutting of tubes is shown in Fig. 7. The motor is mounted on the base of an oscillating cutting head which carries the saw arbor. The cutting head is held back against a stop by means of a coil spring, and is actuated by a foot-treadle through a mechanism which enables the operator to exert the required pressure of the saw on the tube without undue fatigue. The saw is usually 14 inches in diameter and from 3/32 to ⅛ inch thick. A 5-horsepower motor of any suitable type drives the saw at speeds of from 3000 to 4000 revolutions per minute. All exposed working parts are guarded by hinged covers.

Draw-benches and Bending Machines

The No. 1 draw-bench, which has a capacity for drawing tubes up to 2 inches in diameter and up to No. 14 gage, is illustrated in Fig. 8. The No. 2 draw-bench has a capacity up to 3 inches in diameter and up to No. 14 gage. The machines are made in various lengths, and their construction embodies a single heavy steel H-section bolted between head and transmission castings. The chain is of the usual construction, and runs over a steel sprocket driven through double reduction gearing. It is adjusted by a grooved idler wheel, the bearings of which slide in slots in the head casting. The dog is made of steel castings mounted on rollers running on the beam flanges. The dog jaws are machined to accommodate removable grips which may be serrated or machined to grip round tubing without marring it. The draw-benches are

MARTIN DIE-STOCK

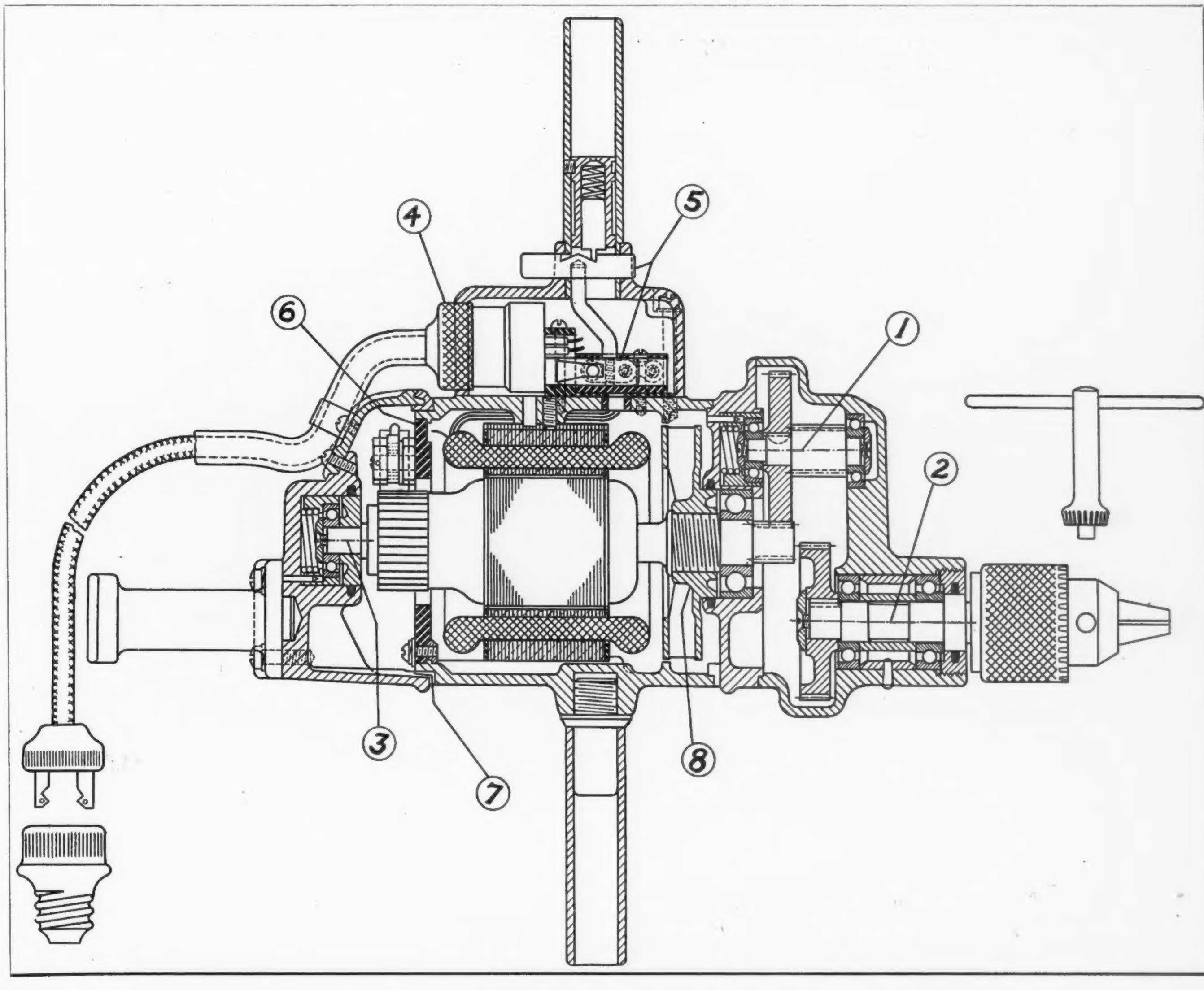
The No. 8 "All-In-One" die-stock shown in the accompanying illustration has just been placed on the market by the Martin Machine Co., Inc., Turner Falls, Mass. This stock will take round dies ranging from ⅝ to 2¼ inches in outside diameter. The loose handle of the stock may be quickly adjusted to line up with a spot hole in the side of a die by means of a sliding block, which is then held firmly in place by tightening two thumb-screws. The point of the die-stock which engages the spot hole of the die is made of hardened tool steel to withstand wear. The advantage of this tool is the possibility of using one stock for dies of various diameters. It is especially intended for the use of machinists, garage men, and plumbers.



No. 8 "All-In-One" Die-stock made by the Martin Machine Co., Inc.

HISEY-WOLF PORTABLE ELECTRIC DRILL

Two sizes of a universal portable electric drill equipped with ball bearings throughout have lately been brought out by the Hisey-Wolf Machine Co., Cincinnati, Ohio, under the trade name of "Super." The Type 38 KU has a capacity for drilling holes up to 3/8 inch in diameter, while the Type 50 KU drills holes up to 1/2 inch in diameter. The distinctive features of this drill may be seen in the accompanying illustration, which shows a sectional view. The motor is built by the Hisey-Wolf Machine Co., and patents are pending for its design. All revolving spindles, three of which are shown at 1, 2, and 3, are fitted with ball bearings. Coil springs are also provided at the bearings to allow expansion and contraction of shafts to take place without resulting in distortion, which is likely to occur with fixed bearings. The quick cable connector 4 permits cable repairs and renewals to be made without dismantling the drill; hence such repairs can be accomplished with a minimum loss of time. Switch 5 is patented and, although externally mounted, is protected by a removable handle cover.



Cross-sectional View of "Super" Universal Portable Electric Drill made by the Hisey-Wolf Machine Co.

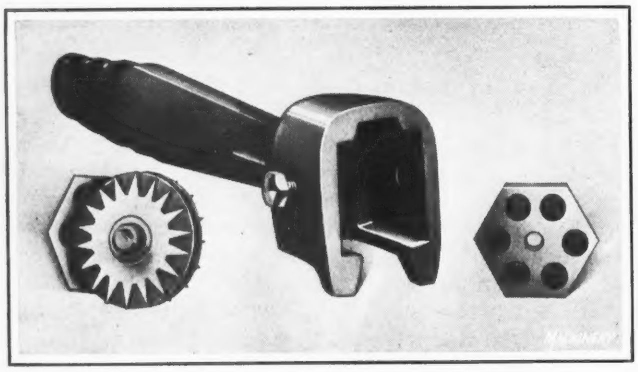
The brush-holder yoke 6 is made of bakelite, and is not affected by oil, moisture, or atmospheric conditions. The complete yoke is adjustable and the brushes can be shifted without dismantling the equipment. Forced ventilation is obtained through vents such as shown at 7, which are so designed that all cool incoming air must pass over the commutator and brushes before being drawn through the motor and expelled. The fan, which is shown at 8, is so designed and mounted as to prevent the lubricating grease in the gear head from working into the motor parts.

LOSHBOUGH-JORDAN INCLINABLE PRESSES

Two recent additions to the line of inclinable presses built by the Loshbough-Jordan Tool & Machine Co., Elkhart, Ind., are known as the "No. 5 Special" and the "No. 0." The No. 5 special press is identical with the regular No. 5 machine described on page 1155 of August, 1918, MACHINERY, except that the die space is 12 inches, whereas on the regular machine it is only 7 inches. The No. 0 press is similar in design to standard presses of the inclinable type built by this concern, but it is of smaller dimensions, some of which are as follows: Opening in bed, 3 by 5 inches; opening through back, 5 1/2 inches; depth of throat, 3 1/2 inches; adjustment of stroke, 4 1/2 inches; and standard stroke, 1 inch. The pressure exerted by the slide is between 5 and 7 tons, for which approximately 1/2 horsepower is required. The weight of the machine is about 300 pounds, and when supplied with a floor stand, 475 pounds.

"DESMOND-HEX" GRINDING WHEEL DRESSER

The accompanying illustration shows the disassembled parts of the "Desmond-Hex" grinding wheel dresser which has just been placed on the market by the Desmond-Stephan Mfg. Co., Urbana, Ohio. An important feature of this dresser is that the parts subject to wear can be readily replaced. The inside of the handle jaws are machined to accommodate hexagonal members having a tapped hole at the center to receive a set-screw, by means of which they are secured to

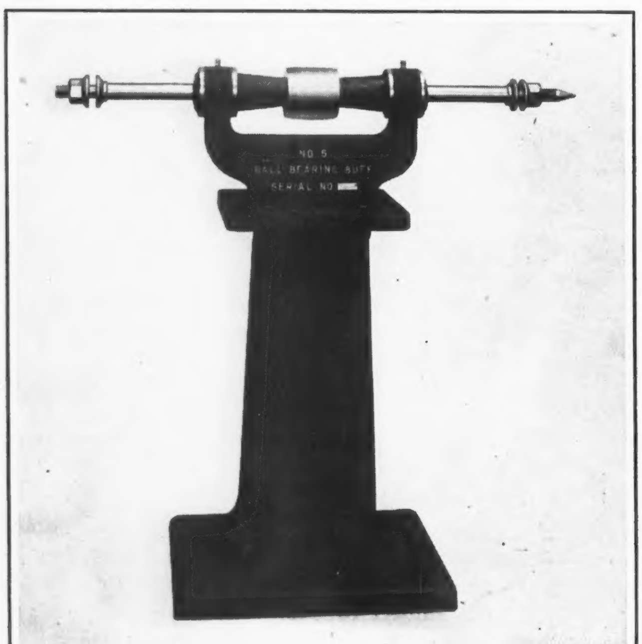


New Design of Grinding Wheel Dresser made by the Desmond-Stephan Mfg. Co.

the handle. These hexagonal members are provided with six circular recesses, any of which may serve as a bearing for the spindle carrying the cutters. Wear during use will be on these recesses, and as a set becomes worn, the hexagonal members are given a sixth turn and the spindle of the cutters advanced to the next set. When all the recesses have been worn out, new hexagonal members may be substituted. The dresser is made in two sizes, one for cutters 1½ inches in diameter, the other for cutters 2⅜ inches in diameter. The small cutter is intended for use on ordinary grinding wheels, while the other size is for large and coarse wheels.

BLOUNT BALL-BEARING BUFFING MACHINES

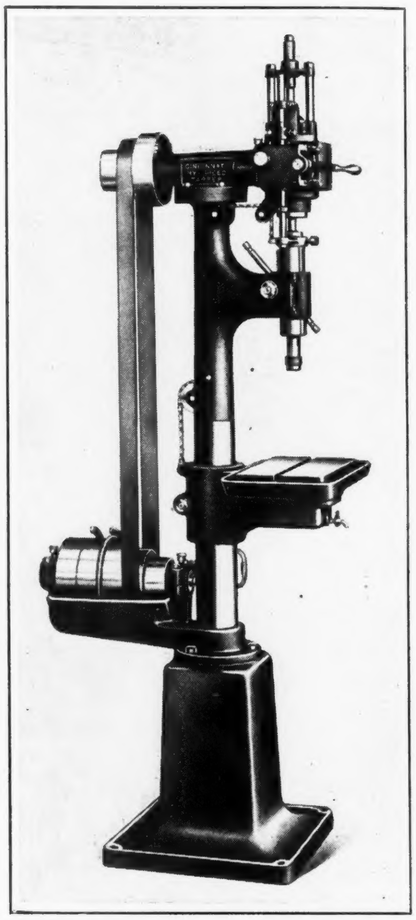
The J. G. Blount Co., Everett, Mass., has just placed on the market a line of ball-bearing buffing machines consisting of three sizes. The No. 5 machine illustrated is the medium size. The design of these machines is very similar to that of the regular buffing machines manufactured by this concern, but an added feature is the S K F ball bearings contained in dustproof mountings, with which they are equipped. The bearings are secured to the spindle by a light driving fit and lock-nuts. The spindles are made of a high-carbon steel, ground to size, and carefully balanced before fitting to the head. A taper point is fitted to the right-hand end of the spindle to accommodate small wheels. The contact surfaces of all parts bolted together are planed or milled to insure a rigid unit. The head can be furnished separate, for mounting on a bench. The countershaft may be of a self-oiling type or equipped with Hyatt roller bearings.



No. 5 Ball-bearing Buffing Machine built by the J. G. Blount Co.

CINCINNATI HY-SPEED AUTOMATIC TAPPING MACHINE

The Cincinnati Hy-Speed Machine Co., Cincinnati, Ohio, has recently developed and placed on the market a line of tapping machines, the operation of which may be semi- or full-automatic. One of these machines is shown in the accompanying illustration. Among the features of these machines are a patented spindle lead and an automatic reversing mechanism. Through the use of the spindle lead device, the tap is fed and returned in a positive way entirely independent of the operator, it being stated that holes are tapped accurately without danger of threads being stripped or taps broken. By giving the stop-plunger at the side of the control handle a half turn, the machine is changed from semi- to full-automatic, or vice versa. When set for semi-automatic operation, the spindle feeds downward, reverses automatically, and stops at the end of the return stroke. To cause the spindle to feed again, the operator merely pulls down on the control lever.



Semi- and Full-automatic Tapping Machine placed on the Market by the Cincinnati Hy-Speed Machine Co.

When set for full-automatic operation, the stop-plunger is withdrawn, and the spindle then reverses automatically at each end of its travel. The spindle can be stopped at any point, reversed and fed again, through the operation of the control lever. Adjustable dogs with limit stops on a trip-rod regulate the depth to be tapped. The chuck is driven by a clutch-end on the spindle, and is locked in position. The machines are equipped with S K F ball bearings throughout, and are regularly furnished for right-hand tapping, but an attachment is included to enable left-hand tapping operations to be performed, this attachment being quickly secured to the end of the rack sleeve. The machines are built in styles having from one to three spindles, and in two sizes of which the maximum tapping capacities are ½ and ⅞ inch diameter in steel, respectively. The ½-inch machine is equipped with tight and loose pulleys, while the ⅞-inch machine is equipped with a single-pulley direct overhead drive. In addition to the type illustrated, the machines are also built in bench and belted motor-drive styles.

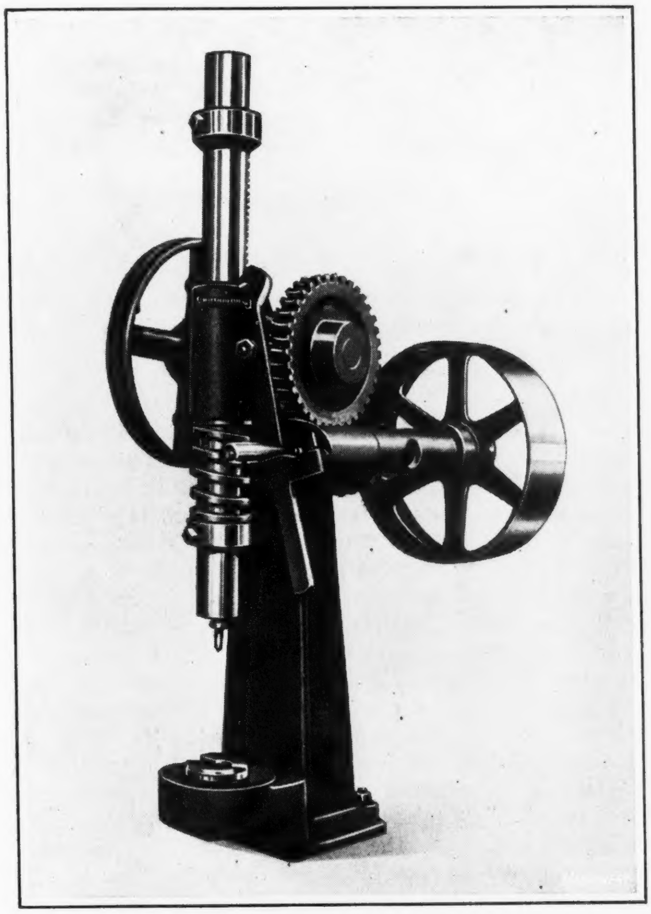
THREE- AND FOUR-WAY INDEX-BASES

In July, 1920, a description appeared in MACHINERY of a two-way index-base for milling and drilling machines, etc., which had been brought out by the Industrial Engineering Co., 407-425 E. Fort St., Detroit, Mich. By means of this index-base, work can be placed on one side of the fixture

table while another part is being machined diametrically opposite. Then when the operation on one piece has been completed, the table can be indexed 180 degrees to bring the unfinished part in line with the cutters. The same company has now placed on the market two more styles of bases which can be indexed to three and four positions, respectively. These bases are made the same dimensions as the original style, 10 and 16 inches in diameter, and the mechanism is based on the same principle.

AMERICAN BENCH BROACH PRESS

A power broach press of a bench type which is being placed on the market by the American Broach & Machine Co., Ann Arbor, Mich., is here illustrated. This machine is intended not only for push broaching operations, but also

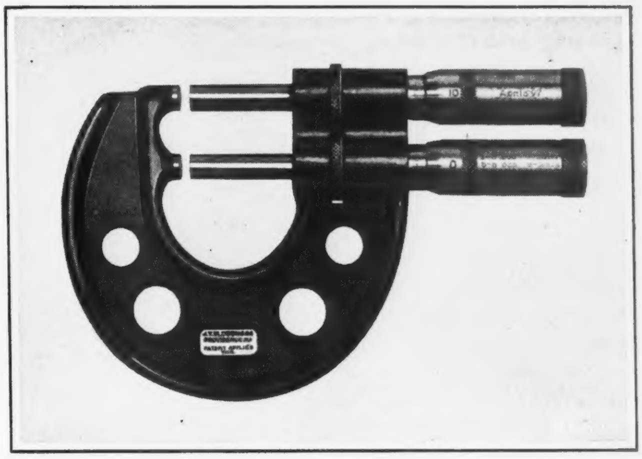


Combination Broaching and Assembling Press developed by the American Broach & Machine Co.

for pressing into place or removing mandrels, bushings, etc. The machine is driven through a pulley 10 inches in diameter, having a face width suitable for a 2½-inch belt. Power from the driving shaft is transmitted through worm-gearing to a steel pinion that engages rack teeth cut directly on the ram. The worm-gearing has a 30 to 1 reduction. The worm is arranged to disengage automatically at the end of a predetermined stroke, through the medium of a collar at the upper end of the ram. Automatic return of the ram is effected through a weight and cord, the rack being wound in a groove around the handwheel. The machine has a stroke of 14 inches, and the bore in the table is 2½ inches in diameter.

SLOCOMB SNAP GAGE MICROMETER

In order to eliminate the necessity of having a large number of snap or limit gages on hand, the J. T. Slocomb Co., Providence, R. I., has brought out a duplex micrometer intended for use as an adjustable limit snap gage. The gaging surfaces are the anvils and spindles of two micrometers,



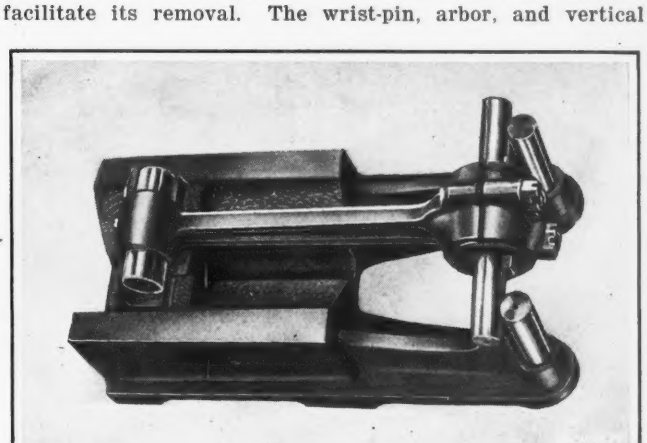
Micrometer Snap Gage produced by the J. T. Slocomb Co.

which are set in the frame of the instrument. The construction will be apparent by reference to the illustration. This design enables any dimension within the range of the micrometers to be gaged by merely setting one spindle to the "Go" dimension and the other to the "Not Go" dimension. Provision is made for locking the spindles after they have been set. Application has been made for a patent covering this instrument.

ALLEN CONNECTING-ROD ALIGNING FIXTURE

A fixture for testing the parallelism of holes and the twist in automobile engine connecting-rods is now being manufactured by the Allen Wrench & Tool Co., Public St., corner of Eddy St., Providence, R. I. From the illustration it will be seen that the base of the fixture is a heavy iron casting having a 45-degree scraped V-bearing for the accommodation of a sliding member. This slide has horizontal and vertical surfaces on which the projecting ends of the wrist-pin in one end of a rod are seated while the rod is being tested. A special arbor is inserted in the crankshaft bearing of the connecting-rod; this arbor rests on two horizontal seats and makes contact with two vertical posts secured to the base. It is held in the bearing by means of a sliding key tapered on the under side to fit a keyway on the arbor, and an eccentrically bored steel bushing that is slotted to receive the projecting tapered key. This construction enables the upper side of the key to bind against the bearing cap as the key is advanced by lightly tapping on its end.

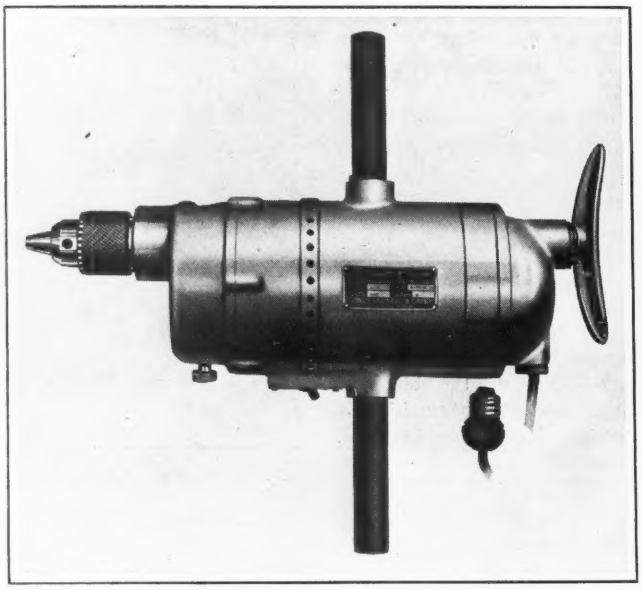
By the use of the eccentric bushing and sliding key it is possible for the outside diameter of the bushing to be slightly less than the diameter of the crankshaft bearing, and so the bushing makes contact on one side of the hole and the taper key diametrically opposite. This feature eliminates the necessity of pressing the bushing into place, and greatly facilitate its removal. The wrist-pin, arbor, and vertical



Fixture made by the Allen Wrench & Tool Co. for detecting Inaccuracies in Connecting-rods

posts are made of steel, hardened and ground to size. By placing a connecting-rod on the fixture in the manner illustrated, and bearing down on the wrist-pin to produce an even contact on the slide, the twist in the rod can be readily detected either by sight or by placing feelers between the under side of one end of the arbor and the seat upon which it is intended to rest. Similarly, if the wrist-pin is held securely against the vertical faces of the slide, deviation from parallelism of the two holes is shown by a space between a post and the corresponding end of the arbor.

The accuracy with which the wrist-pin holes are machined in the piston may be checked by assembling the piston on the connecting-rod and then placing the entire unit on the fixture after the slide has been removed so that the piston will have a two-point bearing in the vee. Inaccuracies are then determined by using the arbor in the crankshaft bearing of the rod in the same manner as when ascertaining the parallelism of the wrist-pin hole with the crankshaft bearing hole. For general garage use it is necessary to provide two arbors, one 1¼ inches in diameter for Ford cars, and another 1½ inches in diameter for other types of automobiles. A complete set of bushings ranges from 1¾ to 2½ inches in outside diameter, varying by increments of ⅛ inch. It is stated that inaccuracies of 0.001 inch can be detected. A pair of bench vise jaws are supplied as auxiliary equipment for use in straightening rods.



One of a Line of Portable Electric Drills manufactured by Jones, MacNeal & Camp

JONES, MAC NEAL & CAMP PORTABLE ELECTRIC DRILLS

The "Power King" portable electric drill shown in the accompanying illustration is made in eight sizes of various capacities for drilling up to 1 inch in diameter, by Jones, MacNeal & Camp, 522 S. Clinton St., Chicago, Ill. Each drill has a patented two-speed mechanism and is equipped with a universal ball-bearing motor. The two-speed mechanism enables the equipment to be used effectively for drilling in either metal or wood and with either carbon or high-speed steel tools. The drill consists of three distinct units; the unit on the drilling end contains all gears and the speed-shifting mechanism. The middle unit contains the motor, switch, and wiring, and the handle end is a protecting cap of sufficient strength to take pressures from a jack or to resist shocks produced by a fall. Combined radial and thrust ball bearings are placed at each end of the driving shaft, and ball bearings are also provided for the motor shaft. The brushes are easily accessible for inspection. A standard three-jaw chuck, interchangeable with a No. 2 Morse taper socket, is supplied as regular equipment. The switch is of the quick make-and-break type and is mounted for convenient operation.

ONSRUD GRINDING TURBINE ATTACHMENTS

A small pneumatic turbine equipped with a grinding arbor, which has been brought out by the Onsrud Machine Works, Inc., 3908-3932 Palmer St., Chicago, Ill., was referred to in October MACHINERY. The accompanying illustrations show two attachments for this turbine which may be supplied to increase its field of usefulness. The attachment shown in Fig. 1 converts the turbine into a bench machine, and thus provides a convenient equipment for the light grinding and sharpening of tools, cutters, dies, and taps. This unit may be used as a portable equipment or it may be mounted permanently in one place. The attachment illustrated in Fig. 2 makes the turbine suitable for the accurate grinding of 60-degree centers. A detachable plug is inserted in the spindle of the tailstock, and a bracket mounted on this plug holds the face of the grinding wheel at the proper angle so that when the tailstock is advanced on the center, the latter will be ground correctly. The tailstock plugs make the attachment applicable to both large and small machines.

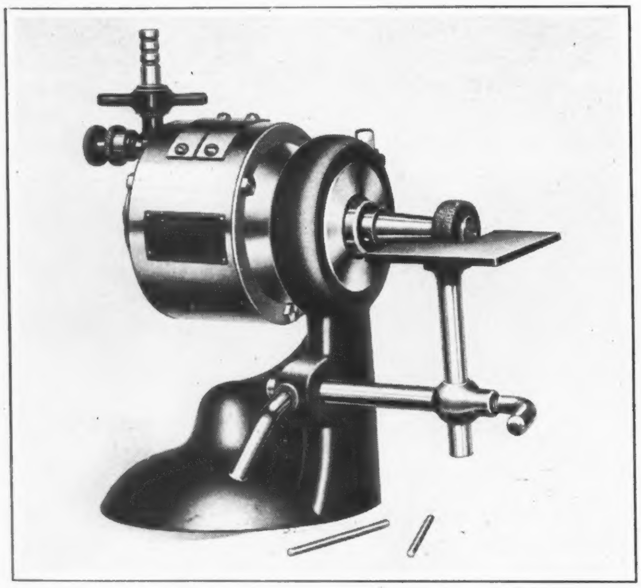


Fig. 1. Bench Stand for Pneumatic Grinding Turbine made by the Onsrud Machine Works, Inc.

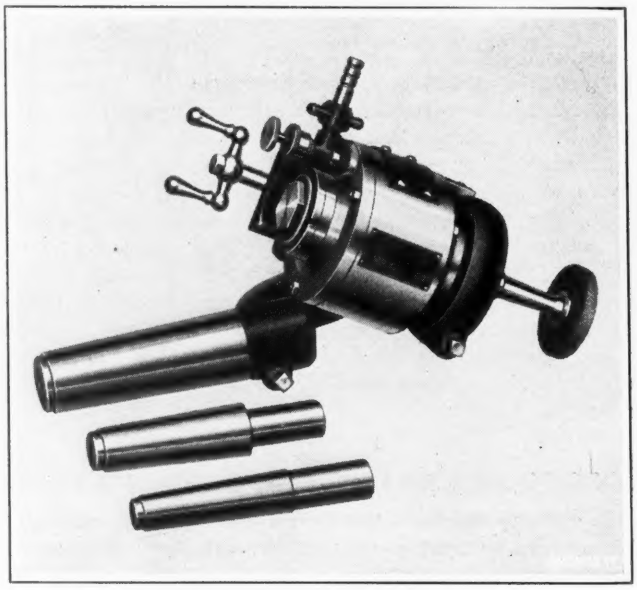


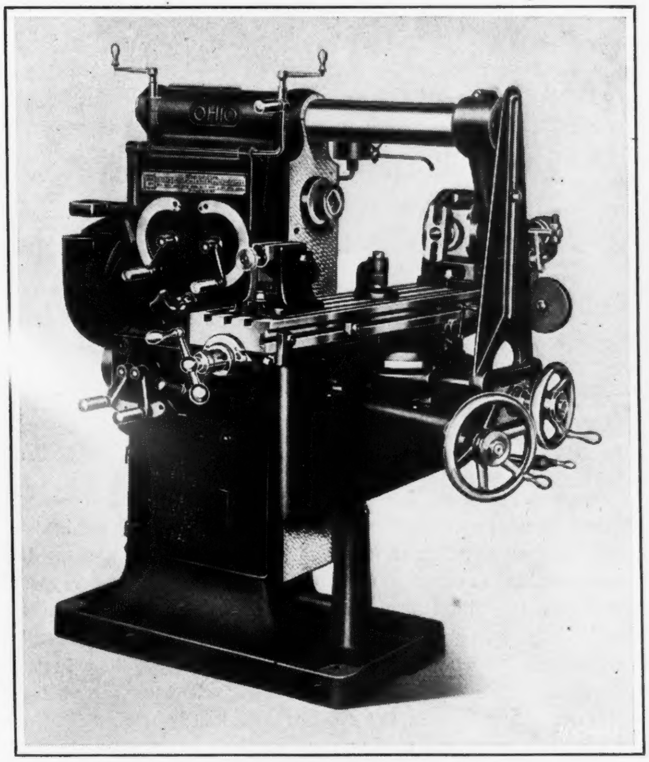
Fig. 2. Attachment which adapts the Pneumatic Turbine for grinding 60-degree Centers

OHIO ALL-GEARED MILLING MACHINES

The Oesterlein Machine Co., Cincinnati, Ohio, has placed on the market a line of milling machines of the constant-speed or all-geared type consisting of six sizes, each of which is made in both plain and universal styles. The No. 2 universal machine is here illustrated. The speed mechanism furnishes sixteen geometric speeds through fifteen gears and 1 shaft, in addition to the spindle and pulley shaft. Speed changes are effected by means of "two-position" levers and a "four-position" knob, the latter controlling the selection of four adjacent spindle speeds. All speed changes may be made without stopping the machine.

Each gear is made from a low-carbon forging that is put through annealing, carburizing, and hardening processes and is sand-blasted to remove furnace scale. Automatic lubrication of the machine is effected by a system of three reservoirs; in the first of these, which is located in the top of the column, the fresh oil is poured. This oil seeps through felt and runs down tubing to cavities cast under the main spindle bearings, the intermediate shaft bearings, and the driving pulley. The oil is carried to the spindle bearings by means of wicks that dip into the cavities under the spindle. By this arrangement only fresh oil is admitted to the bearings that are heavily loaded. The oil passing through these bearings overflows into a second reservoir from which it is distributed to the speed gears and minor bearings by splash lubrication. The overflow from the second reservoir passes to the speed-box, which is the third reservoir, this being also oiled by splash lubrication. The capacity of the first reservoir is sufficient to supply the machine for about two months of ordinary service. Provision is made for raising the level of the oil in the last reservoir if the established level should decrease.

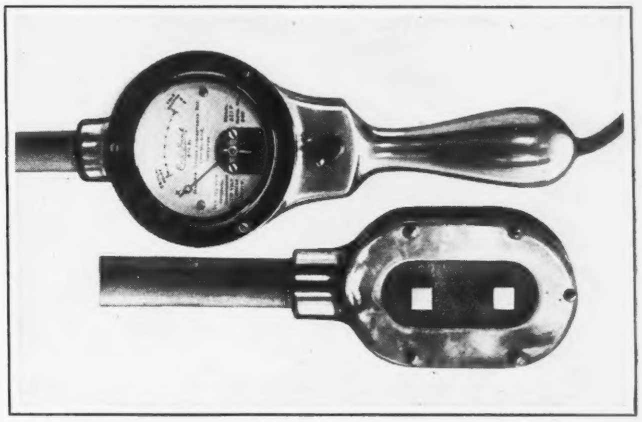
The driving pulley on each machine is 14 inches in diameter and runs at the rate of 400 revolutions per minute. A brake designed for stopping the spindle quickly is connected with the belt-shifter in such a way that as the belt is partially carried to the loose pulley, the brake is applied to the tight pulley by means of a spring-plunger releasing mechanism. The feed-box, knee, and table are similar to those supplied on the cone-type milling machines built by the same concern.



No. 2 All-geared Universal Milling Machine developed by the Oesterlein Machine Co.

"CRIT-POINT" HEAT-TREATING INSTRUMENT

Several years ago, the "Crit-Point," an instrument used in hardening steels, was placed on the market by the Gibb Instrument Co., Detroit, Mich. Patents and manufacturing rights for this instrument have now been taken over by the Illinois Testing Laboratories, Inc., 430 S. Green St., Chicago, Ill., and the instrument has been completely redesigned. The device is employed to indicate when the critical points are reached in heat-treating steels so as to enable the work to be hardened between these points. Steels lose their magnetic properties when heated to the decalescent point, and the principle upon which the device is based is to detect the absence of the magnetic properties.



Instrument made by the Illinois Testing Laboratories, Inc., for indicating Critical Points when heat-treating Steel

The instrument is used by making contact with the work in the furnace through the medium of special iron cores surrounded with two heat-proof electromagnets forming a small transformer, these coils being connected to the source of current and a suitable voltmeter. When the steel being heated becomes non-magnetic, a small amount of current is imparted to the voltmeter, causing the indicator on the instrument dial to move to the position marked "critical point." The dial end of the instrument is shown in the upper portion of the accompanying illustration while the end placed in contact with the work is shown in the lower portion, these two ends being connected by a long rod. This device is made in two types: Model 220 P is a portable unit, which is used by attaching it to a conveniently located electric light socket. Model 220 W is intended for use as a permanently installed instrument in connection with suitable switch and wire arrangements. Such an installation permits the use of one large instrument on several furnaces. Modifications of the fire-end are possible to permit its use with special shaped articles and under unusual conditions.

ST. LOUIS GRINDING AND POLISHING MACHINES

Among a complete line of grinding and polishing machines lately developed by the St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo., are the machines shown in the accompanying illustrations. The machine to the left in Fig. 1 is a grinding machine, while the machine to the right is equipped for polishing. A machine of the same general design but arranged for mounting a grinding wheel on one end of the spindle and a polishing wheel on the other end, is also built. Each machine is driven by belt from a fully enclosed motor of the repulsion start induction run type, either single- or three-phase squirrel-cage. The three phase motor will operate on only three-phase lines at one voltage, while the single-phase motor will operate on a one-, two- or three-phase current and at 110 or 220 volts. A

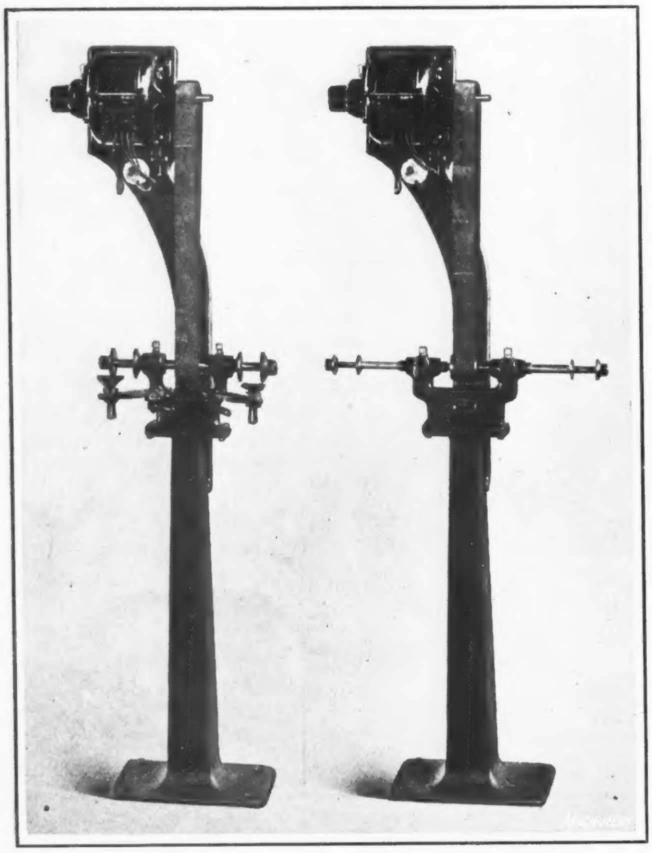


Fig. 1. Grinding and Polishing Machines of a Line brought out by the St. Louis Machine Tool Co.

direct-current motor may also be supplied. The wheels on the grinding machine are driven at a surface speed of 5000 feet per minute, and those on the polishing machine, at a surface speed of 7500 feet per minute. These machines are made in a large range of sizes and in stationary and portable types. The weight of the smallest size of portable machine is 170 pounds, and that of the largest, 290 pounds.

The heavy floor-type grinding machine illustrated in Fig. 2 is built in three sizes for which the dimensions of the grinding wheels recommended are 18 by 3 inches, 20 by 3 inches, and 24 by 4 inches, respectively. The arbors are made from 0.40 per cent carbon steel and have coarse-pitch square threads. The machine is driven through a pulley which may be either of a plain or cone type as desired. The bearings are provided with large oil chambers, which are filled and drained through a pipe connection at the back, so arranged as to prevent overflow of oil. The weight of the smallest size of this machine is 700 pounds, and that of the largest, 1000 pounds.

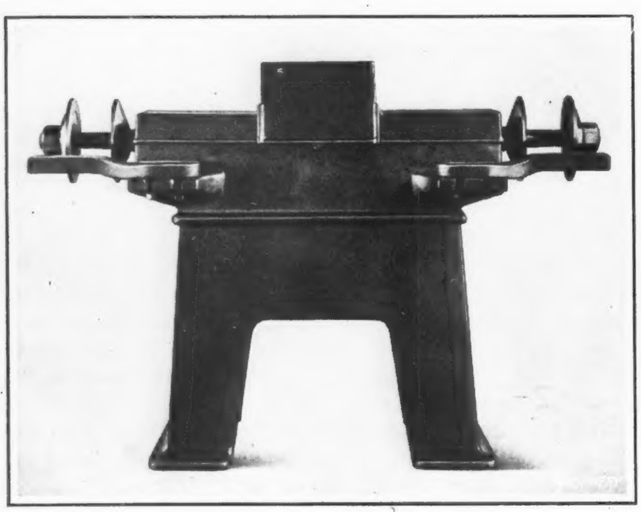


Fig. 2. St. Louis Heavy Floor Grinding Machine

STROMBERG PROCESS TIMING AND SIGNALING INSTRUMENT

For use in manufacturing processes where the element of time is a factor, such as the heat-treatment of steel and rubber, the molding of insulating materials and enameling, plating, etching, and similar operations, the Stromberg Electric Co., 209 W. Jackson Blvd., Chicago, Ill., has developed a line of timing and signaling instruments, one of which is here illustrated. Each instrument is driven by a small synchronous motor connecting to any convenient alternating-current circuit. There are two indicating hands for the dial which are enameled red and black, respectively. The red pointer is set to indicate the length of the process, after which it remains stationary while the arrow indicator travels from this point to zero. When the latter point is reached, the duration of the process is at an end, and a signal (either a light or a bell) is operated until stopped by the attendant. At any position of the arrow pointer, the remaining time of the process can be ascertained by noting the graduation to which the pointer indicates.

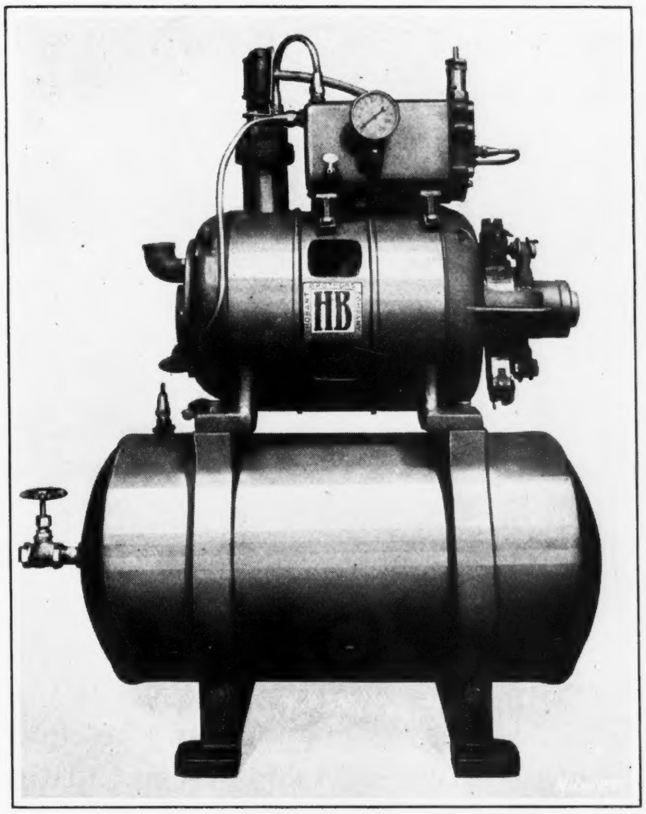
Three buttons on the face of the housing control the indicating hands. By pushing in the one on the right and turning it, the setting hand may be placed to any graduation on the dial. By means of the button at the bottom of the case, the arrow hand, after having reached zero, may be quickly returned to the position of the setting hand for

Process Timing and Signaling Instrument developed by the Stromberg Electric Co.

a second process of the same duration. The third button is used to start the arrow hand toward zero. The instruments are made with four standard dials which are graded in seconds, three-seconds, half-minutes, and minutes, respectively, and the maximum lengths of process which can be timed are 3 minutes 48 seconds, 11 minutes 24 seconds, 57 minutes, and 1 hour 54 minutes, respectively. The instrument illustrated is equipped with the 57-minute dial, so that the setting hand indicates twelve minutes while the arrow hand points to four minutes.

HOBART AUTOMATIC AIR COMPRESSOR

Automatic maintenance of air pressures between 125 and 140 pounds per square inch, or higher, in compressed air lines is the service for which the direct motor-driven compressor here illustrated has been designed by the Hobart Bros. Co., Troy, Ohio. An interesting feature of the outfit is a pressure release or magnetic pressure unloader, which

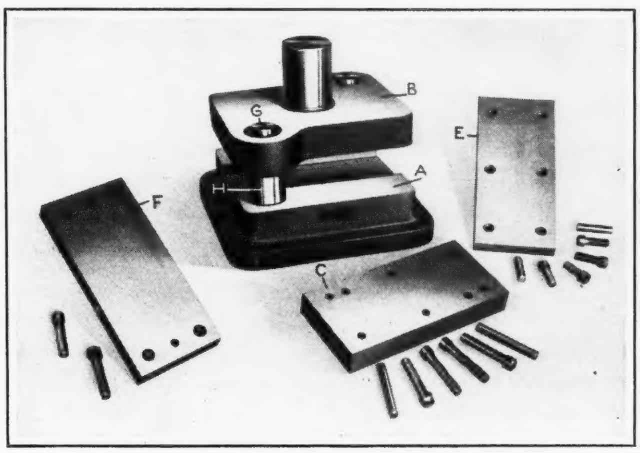


Gearless Automatic Air Compressor brought out by the Hobart Bros. Co.

automatically holds open the compressor valve until the motor develops full speed, and then releases when the outfit begins pumping. The pump is mounted directly on the motor shaft. The motor operates at a speed of 600 revolutions per minute, and is equipped with ball bearings to insure quiet running. The motor and pump housing is mounted directly on the tank, and on top of the motor and pump housing are located the air and oil filter, air gage, and automatic switch which starts up the motor without attention. This method of assembling the unit has resulted in a compact equipment. The current for the motor may be supplied from a light or power line.

DIAMANT STANDARD PUNCH AND DIE SETS

Certain detail parts of punch and die sets are invariably the same as regards shape, size, and the method of machining, and in order to reduce the cost of punches and dies and to enable sets to be provided for a new job with minimum delay, the Diamant Tool & Mfg. Co., Inc., 95 Runyon St., Newark, N. J., is manufacturing, on a quantity production basis, a line of standard parts that are complete in every respect except for the die openings and the holes for inserting punches in the punch-plate. Referring to the illustration, the standard parts consist of die-shoe *A*, punch-holder *B*, die blank *C*, stripper-plate *E*, punch-plate *F*, liner pins *G*, liner pin bushings *H*, and the necessary dowels and screws.



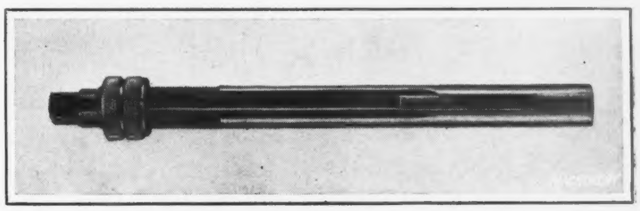
Standardized Punch and Die Parts made by the Diamant Tool & Mfg. Co., Inc.

When the designing stage of a die has been completed, a diemaker can take one of these sets and, by machining the openings in the die, stripper- and punch-plate and assembling the parts, have the die quickly ready for use. Although the dowel holes are shown on the parts in the illustration, these holes are not drilled when the parts are supplied to a customer, because different conditions control their location. The die blank is made of an oil-hardened tool steel, and is from 0.006 to 0.010 inch over size in width to allow for shrinkage in hardening and for final grinding of the sides.

In addition to the style of die-shoe illustrated, one is made with U-lugs at the ends for securing it to the machine, instead of having a flange running around the base. The slot in the die-shoe may run lengthwise or crosswise, or the shoe may be furnished without any slot. A set is also made with both liner pins at the rear rather than placed diagonally as shown. When a customer does not want all the parts mentioned, a four-component set, consisting of a punch-holder, die-shoe, liner pins, and liner pin bushings, can be furnished. All sets are made in a number of sizes.

LARSON ADJUSTABLE REAMER

An adjustable reamer known as the "Larson," which is being manufactured by the Standard Tool & Supply Co., 651 S. Polk Ave., Mason City, Iowa, is designed especially for reaming the bushings of automobile pistons. In use, the reamer is inserted through both bushings, thus insuring proper alignment, and then expanded by turning the adjustable nut so as to permit the spring in the reamer at the opposite end to actuate the cutter-blade. One complete turn of the adjusting nut causes the reamer to be enlarged 0.001 inch. The cutter-blade is of a double-edge type, so that it can be rotated in either direction. It can be readily sharpened, replaced, or shimmed up.



Tool for reaming Bushings of Automobile Pistons which is made by the Standard Tool & Supply Co.

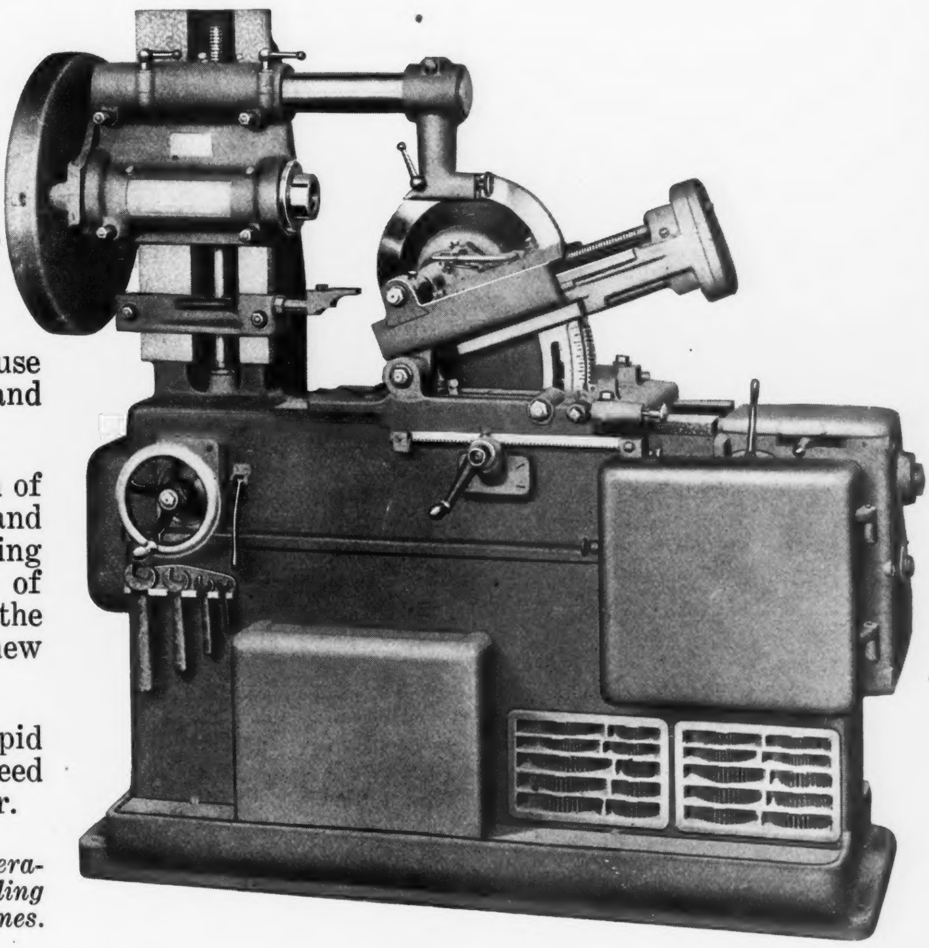
OLIVER NO. 1 UNIVERSAL VISE

A recent product added to the line of patternmakers' and woodworkers' equipment manufactured by the Oliver Machinery Co., Grand Rapids, Mich., is a No. 1 universal vise, which is shown in the illustration with the jaws in horizontal positions and an angle jaw in place. The usual mounting of this vise, of course, is with the jaws in vertical planes. The jaws are 7¼ inches wide, 18 inches long, and open up to a distance of 16 inches. The steel screw for the jaws has a double-buttress thread and a self-centering and detachable nut which can be readily removed for replacement. The jaws may be clamped in any position about a complete circle. The angle jaw is detachable and used with small irregular shaped pieces. The locking bar is flat and so prevents slipping of the vise, regardless of the position in which the jaws are set. The swiveling front jaw pivots at the center,

quickly and accurately

Automatic Gear Cutting Machines

Rapidity of production is secured by



1. Rapid return of the cutter slide at a constant speed independent of feed or speed of the cutter.

2. Rugged construction of the work spindle and cutter slide, permitting the use of high speeds and coarse feeds.

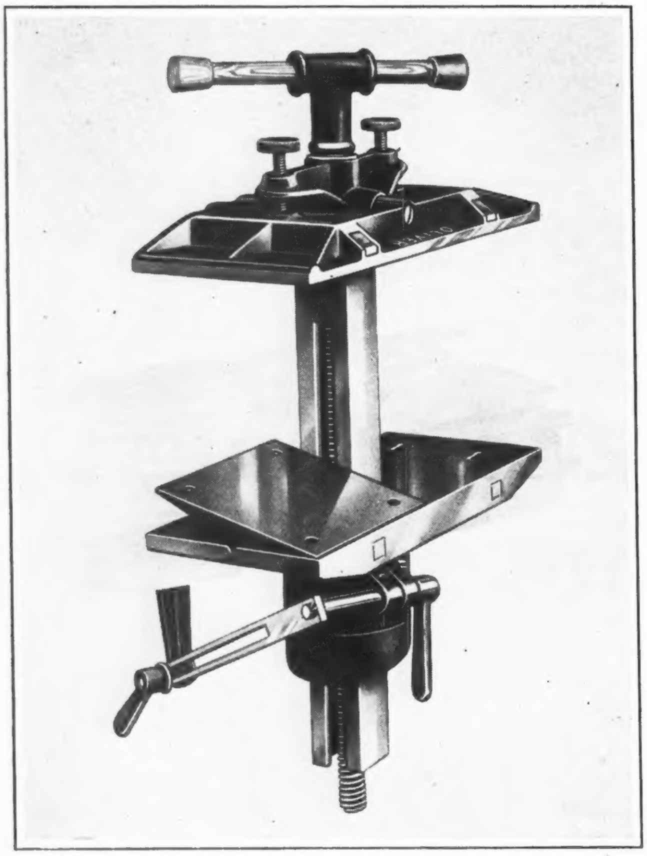
3. The simple design of the work spindle and arbor supports, allowing the rapid removal of finished gears and the quick insertion of new blanks.

4. Indexing at a rapid rate independent of feed or speed of the cutter.

Send for descriptive literature and Catalog 137 telling more about these machines.

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I., U. S. A.

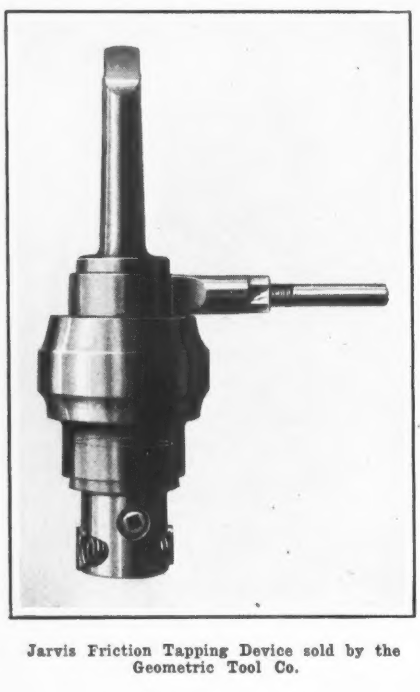


Vise for Woodworkers and Patternmakers, which is a Recent Product of the Oliver Machinery Co.

and therefore, can be set by means of thumb screws to take a wedge-shaped piece. Work can also be clamped on parallel sides without resetting the adjusting screws. The tilting feature of the jaws makes the vise convenient for working on frames and box forms. Dogs provided on the jaws facilitate the clamping of irregular and thin work.

JARVIS FRICTION TAPPING DEVICE

The feature of the Jarvis Style FD tapping device here illustrated, which is now being introduced to the trade by the Geometric Tool Co., New Haven, Conn., is a cone friction drive that is controlled by the pressure exerted on the machine spindle with which the device is employed. The dotted lines in the illustration indicate the relative size of the friction cone. Little pressure is necessary to drive this tool, and the starting and stopping of the tap while the spindle is rotating is under a free control. The device is equipped with a standard chuck. The tapping range is from 0 to 1/4 inch in diameter, the device being suitable for the tapping of light holes in tough metal.

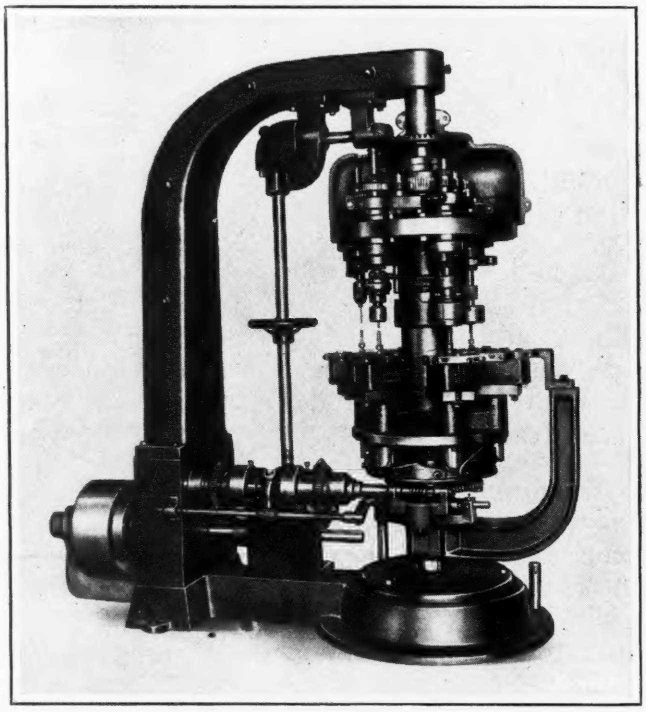


Jarvis Friction Tapping Device sold by the Geometric Tool Co.

JACKSON VERTICAL AUTOMATIC CHUCKING MACHINE

The Jackson vertical automatic chucking machine described in December, 1920, MACHINERY is now being brought out in several redesigned types by the Vertomatic Mfg. Co., Third and Buttonwood Sts., Reading, Pa., one of which is shown in the illustration. Type A is intended for work requiring a series of from three to five operations at one setting, such as spotting, sizing, facing, threading, and tapping. Type B is for work requiring two or three operations. These two machines are identical in construction, except that Type A has six chucks and five active spindles while Type B has four double chucks and three pairs of spindles. By providing one less spindle than the number of chucks, one chuck can be unloaded and loaded without interfering with the continuous operation of the machine.

The Type C machine is for work requiring but one operation or two operations performed by a combination tool, such as the facing and tapping of nuts or the pointing and threading of bolts. Types A and B are indexing machines on which the spindles remain stationary while the chucks are fed to the tools, independently of each other, at the desired speed and to the proper height, by the use of cams. When the chucks are dropped, the chuck turret is indexed to the next working position. On the Type C machine, each spindle is mated with a certain chuck, and operates on the work placed in that particular chuck. The chuck and the spindle turrets are locked together and rotated in one direction. As the chucks leave the loading station they run up a continuous cam so that the work is raised to the tool in the spindle. The work is ejected when returned to the loading station. The machines are automatic throughout.



Vertical Automatic Chucking Machine redesigned by the Vertomatic Mfg. Co.

* * *

The College of the City of New York announces a course in cost reduction, largely in the interests of those already actively engaged in manufacture or commerce. The course is principally devoted to an analysis of the causes of expenses that may be either prevented or reduced, and to various financial, technical, organizational, or other remedies. Concrete examples from machine shops, foundries, etc., will be presented, and definite methods for reducing costs of material and labor and of overhead will be included.

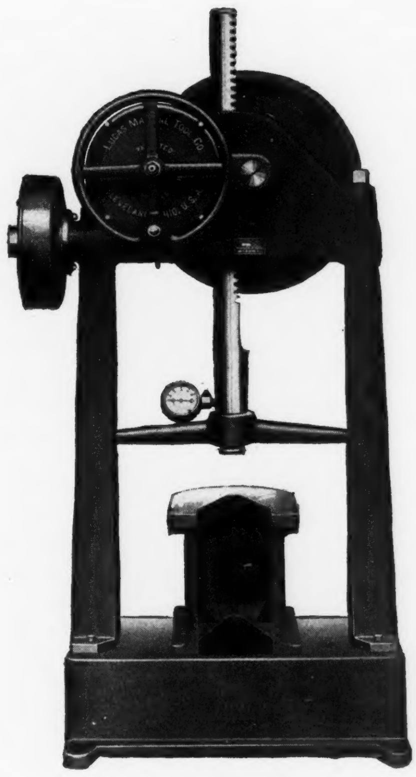
Take Us Into Your Confidence!

We frequently run across some peculiar job that can be done on the

LUCAS
Power Forcing Press

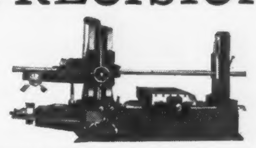
better than on any other machine.

If you have any jobs requiring pressure let us look them over, maybe we can help.



Illustrated Circular
Tells the Whole Story

WE ALSO MAKE THE
"PRECISION"



BORING, DRILLING AND MILLING MACHINE

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Aux Forges de Vulcain, Paris. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

NEW MACHINERY AND TOOLS NOTES

Gas Pressure Regulator: Alexander Milburn Co., 1420 W. Baltimore St., Baltimore, Md. A pressure regulator intended for the control and delivery of acetylene, oxygen, hydrogen, and other gases under high pressure, such as are used in welding. This device is said to maintain a constant predetermined pressure, regardless of fluctuations in the initial pressure line and variations in consumption at the torch.

Oil Reclaiming Outfit: S. F. Bowser & Co., Inc., Fort Wayne, Ind. An outfit adapted for reclaiming different kinds of lubricating oils, but especially intended for use on oils employed in internal combustion engines. The apparatus is said to restore the oil to its original viscosity, flash-point, and purity. The outfit is made in two sizes with capacities of 50 and 100 gallons, respectively, per twenty-four hours.

Adjustable Boring-bars: Power-Vosberg Co., Detroit, Mich. Adjustable boring-bars made in three styles (the angle adjustable, straight adjustable, and removable block types) for boring holes from 7/8 to 15 inches in diameter. These bars are intended for both rough- and finish-boring and reaming, and can be used on drilling machines, lathes, boring mills and other machine tools. The sales agent is the Firmhil Machine Supply Co., 602 Kerr Bldg., Detroit, Mich.

Combination Lathe and Grinding and Drilling Machine: Electric Motor Mfg. Co., Ludington, Mich. A combination machine sold under the trade name of "Utility," which is designed to handle a wide range of repair work requiring lathe, drilling, and grinding operations. The machine is driven by an electric motor, and is intended for bench use. The grinding wheel is mounted on the motor shaft, while the lathe spindle is driven from the motor shaft by gears.

Bench Drilling Machine: Model Specialty Co., 401 E. 19th St., New York City. A small portable bench drilling machine weighing only 34 pounds, which is intended for accurate work and all-around shop use. The column is high enough to permit objects up to 18 inches in height to be drilled. The table can be tilted to any angle and locked in position. The spindle is driven directly from a motor, and the head carrying the spindle and the motor can be positioned at any point on the column.

Brinell Hardness-testing Punch: Case Hardening Service Co., 2279 Scranton Road, Cleveland, Ohio. A punch for quick hardness testing by the Brinell method. A spring hammer in the barrel delivers to a 1/4-inch steel ball inside the cap at the bottom, a blow of sufficient force to make a depression of three millimeters diameter or less, according to the hardness of the test piece. The test is accomplished by gripping the knurled barrel of the punch and pressing downward quickly until the spring hammer is released.

* * *

NEW BOOK ON EMPLOYMENT METHODS

Employment Management, Wage Systems, and Rate Setting. 103 pages, 6 by 9 inches; 32 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $1.

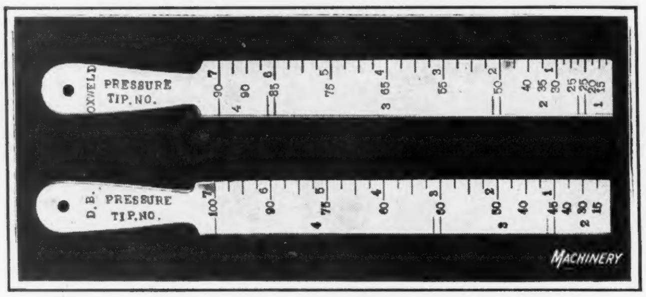
Haphazard methods of hiring men and of determining their compensation have probably caused more dissatisfaction on the part of labor and greater production losses to manufacturers than any other single factor. In addition to the manufacturers' losses the losses of employes due to being placed at work for which they are not adapted, are also very great. No doubt such losses are to some extent unavoidable, but more care on the part of those who hire would eliminate a large percentage of this waste. The problem expressed in simple language is to fit the "round pegs" in round holes and the "square pegs" in square holes.

This treatise deals with systems for use in employing men and placing them where they can do the most effective work; it also covers wage payment systems, explains the fundamental principles involved, and presents certain approved plans for determining compensation on the basis of individual merit. Articles on these different subjects previously published in Machinery aroused such interest among shop executives that it was decided to use them as the basis for this treatise, especially in view of the fact that the systems described have proved successful in well organized manufacturing plants. This material was contributed by several authorities, including W. D. Stearns, Secretary of the Occupations and Rates Committee of the Westinghouse Electric & Mfg. Co.; John C. Bower, Superintendent of the Employment Department, Westinghouse Electric & Mfg. Co.; R. K. Le Blond Machine Tool Co.; A. H. Dittmer, President of the Dittmer Gear & Mfg. Corporation; Russell Waldo; J. B. Conway; and John C. Spence, Superintendent of the Grinding Machine Division of the Norton Co.

RULE FOR OXY-ACETYLENE CUTTERS

A convenient rule for metal cutters who use the oxy-acetylene blowpipe was devised recently by K. McDermott, steam engineer and assistant mechanical engineer of the South Chicago Works of the Illinois Steel Co. It is in the form of a nickel-plated hand rule, about 12 inches long by 1 1/8 inches wide and 1/8 inch thick, so graduated as to indicate the tip sizes and oxygen pressures best suited for cutting steel sections of any thickness up to 7 inches. The rule shown in the accompanying illustration is graduated for use with "Oxweld" and Davis-Bournonville tips. As a common scale would not apply to both of these makes, one side of the rule is graduated for the "Oxweld" and the other for the Davis-Bournonville tips, as shown.

The device is simple and can be applied easily. Instead of reading thickness in inches and fractions, the tip size and pressure are read off directly, thus making it unnecessary to resort to memory or refer to a cutting table. The device saves time and eliminates waste by providing a simple means of determining the proper size of tip and the correct pressure to employ for each job. The idea is not patented, and anyone can easily make a rule of this type adapted for the equipment being used.



Metal-cutters' Rule for determining Correct Tip Size and Oxygen Pressure

* * *

CONVENTION OF INDUSTRIAL ENGINEERS

The fall convention of the Society of Industrial Engineers was held in Springfield, Mass., in the Municipal Auditorium, October 5 to 7. The principal subject of the meeting was industrial stability. In addition to the main gatherings, sectional meetings were held for the groups dealing with the departments of education, manufacture and selling, financing and accounting, and industrial relations. Tours of inspection were made to the principal manufacturing plants of Springfield and the vicinity. The officers elected for the year 1922 were as follows: President, Joseph W. Roe, head of the industrial engineering department of New York University; treasurer, F. C. Schwedtman, vice-president of the National City Bank, New York; secretary, W. G. Sheehan of Detroit, Mich.; and business manager, George C. Dent of Chicago, Ill.

* * *

The Board of Education of the City of New York offers during the coming winter evening courses in machine shop practice, machine shop theory and acetylene welding at a number of the evening trade schools in the city. The courses are open to those now employed in some branch of the industry, and the instruction given is to be supplementary to the day-time occupation, the aim being to fit the worker for greater earning capacity. Courses will also be given in shop mathematics, toolmaking and millwrighting.

* * *

The index to the twenty-seventh volume of Machinery, covering the year September, 1920, to August, 1921 inclusive, is ready for distribution, and copies will be sent upon request.

THE CELEBRATED
"F & G"
(Felten & Guilleaume)

IMPORTED POLISHED STEEL
MUSIC WIRE

Is Unexcelled for Use in

Electrical Work, Calculating Machines, Automatic Machines of all kinds, Typewriters, Adding Machines, Knitting and Weaving Machinery, Carpet Sweepers, Vacuum Cleaners, Mechanical Toys, for Dental and Surgical Work, in fact anywhere where a positively safe and perfect wire must be used.

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Tell us your particular requirements, or better still try out a small lot.

If your springs are made on the outside it will be to your advantage *to insist* they be made of "F & G" wire.

Special Circular No. 232 upon request.

Hammacher, Schlemmer & Co.

Hardware, Tools and Factory Supplies

New York Since 1848 **4th Ave. & 13th st.**

OBITUARIES

ALLAN RANSOM, who was closely connected with the machine tool industry for many years, died in San Francisco, September 21, at the age of sixty-one. Mr. Ransom was associated at one time with the Lodge & Davis Machine Tool Co., in Cincinnati, and later was in the Chicago store of the Prentiss Tool & Supply Co. For a number of years he was one of the partners of the Marshall & Huschart Machinery Co. of Chicago.

* * *

PERSONALS

LYLE W. ORR has resigned as general manager of the Modern Tool Co., Erie, Pa., with whom he had been connected for ten years. His plans for the future have not yet been announced.

ALAN A. WOOD, for a number of years connected in an engineering and sales capacity with the Providence plant of the Builders Iron Foundry and the Diamond Machine Co., associated companies, is now sales manager of the Philadelphia district, and is located at 419 Widener Bldg., Philadelphia, Pa.

M. A. GREEN, who for ten years was superintendent of branches and agencies of the Crucible Steel Co. of America, has become associated with the Newman-Andrew Co., 26 Cortlandt St., New York City, as manager of its tool steel department. Mr. Green's experience in the tool steel field extends over a period of more than twenty years.

GEORGE L. SAWYER, formerly sales manager of material handling machinery for the Barber-Greene Co., Aurora, Ill., has been appointed New York representative of the Universal Crane Co., Cleveland, Ohio, for the sale of universal cranes. His headquarters will be at the Allied Machinery Center, 141 Center St., New York City.

FRITZ R. LINDH, formerly chief engineer of the Graton & Knight Mfg. Co., Worcester, Mass., has joined the sales organization of the Chicago Belting Co., Chicago, Ill. Mr. Lindh will be in charge of the Pittsburg factory branch, and will also make personal engineering surveys for many of the larger users of belting throughout the United States. His headquarters will be at 336 Third Ave., Pittsburg.

MORTIMER ELWYN COOLEY, dean of the College of Engineering and Architecture of the University of Michigan, has been elected president of the American Engineering Council of the Federated American Engineering Societies. Mr. Cooley is a past president of the American Society of Mechanical Engineers, and has a long record of distinguished service in education under the government and in private capacities.

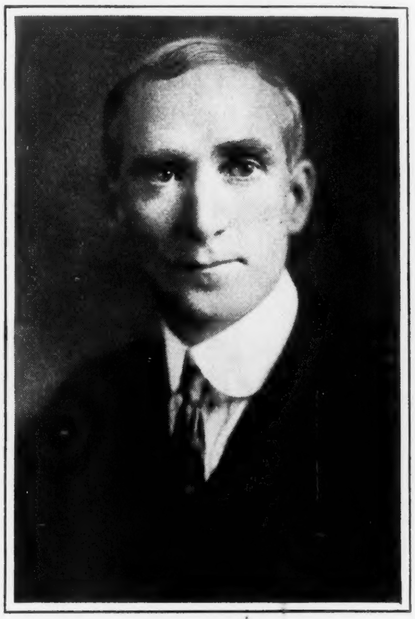
WILLIAM H. SEVERNS has been appointed assistant professor of mechanical engineering at the College of Engineering, University of Illinois, Urbana, Ill. Professor Severns was graduated from the University of Kansas in 1914, and since then has served as instructor at the University of Kansas, Purdue University, New Hampshire College, University of Wisconsin, and University of Illinois. He has also been employed as assistant field engineer by the New Jersey Zinc Co., Palmerton, Pa.

R. A. LUNDQUIST of Minneapolis, Minn., will head the newly created electrical machinery division of the Bureau of Foreign and Domestic Commerce. This is one of the new industrial divisions made possible by Congress through the Export Industries Act. It is expected to secure the services of experts to specialize on the more important export commodities. Mr. Lundquist is a graduate of the University of Minnesota, and an electrical engineer of wide experience. He has also made extensive studies of the sale of electrical machinery in Australia, New Zealand, China, Japan, and South Africa, the results of which have been published by the Bureau of Foreign and Domestic Commerce.

* * *

NEW PRESIDENT OF THE A. S. M. E.

Dexter S. Kimball, dean of the College of Engineering of Cornell University, has been elected president of the American Society of Mechanical Engineers, and will take office at the next annual meeting to be held in New York City early in December. Dean Kimball was born in New River, New Brunswick, Canada, in 1865, and graduated from the Leland Stanford Jr. University in 1896. He served his apprenticeship with Pope & Talbot, Port Gamble, Wash., and in the shops and the engineering department of the Union Iron Works, San Francisco. In 1898 he became designing engineer for the Anaconda Mining Co. For three years he served as assistant professor of machine design at Sibley College, Cornell University, and later became works manager for the Stanley Electric Mfg. Co., Pittsfield, Mass. In 1904 he returned to Cornell University as professor of machine design and construction, and since 1915 he has occupied the chair of industrial engineering. He became Dean of the College of Engineering in 1920.



Dexter S. Kimball, Newly Elected President of the American Society of Mechanical Engineers

Since 1911, Dean Kimball has been a member of the Council on Industrial Engineering, New York State Department of Education. He is also a member of the Society for the Promotion of Engineering Education, and of the Society of Industrial Engineers. He is vice-president of The Federated American Engineering Societies. He is co-author with John H. Barr of "Elements of Machine Design," and author of "Industrial Education," "Principles of Industrial Organization," "Elements of Cost Finding," and "Plant Management," as well as of many contributions to the technical press.

Dean Kimball became a member of the American Society of Mechanical Engineers in 1900. He has served as chairman of the Committee on Meetings and Program of the society, having charge of the professional features of the annual and spring meetings. He has also served on the Committee on Aims and Organization and as chairman of the sub-committee on Relation of the Engineer to his Work. He was elected a manager of the society in 1919.

COMING EVENTS

November 1-4—Annual convention of the Industrial Relations Association of America in New York City; headquarters, Waldorf-Astoria Hotel. Acting executive secretary, E. A. Shay, 671 Broad St., Newark, N. J.

November 2-4—Fall conference of Industrial Cost Association in Pittsburg, Pa. Headquarters of the association, 2828 Smallman St., Pittsburg.

November 4-5—Regional meeting of the American Society of Mechanical Engineers in Kansas City, Mo.

December 1-3—Fall meeting of the Taylor Society in New York City. Secretary, Harlow S. Pearson, 29 W. 39th St., New York City.

December 6-9—Annual convention of the American Society of Mechanical Engineers in the Engineering Societies' Building, 29 W. 39th St., New York City.

May 8-11, 1922—Spring meeting of the American Society of Mechanical Engineers in Atlanta, Ga. Assistant Secretary (Meetings), C. E. Davies, 29 W. 39th St., New York City.

The sectional meetings of the American Society of Mechanical Engineers for the month of November are as follows: **November 1**—Cleveland Section at Hotel Winton, Cleveland, Ohio, and Virginia Section at Richmond, Va.; **November 2**—Buffalo Section at the Lafayette Hotel, Buffalo, N. Y.; **November 3**—Hartford Section at the Bond Hotel, Hartford, Conn.; **November 8**—Waterbury Section at the Chamber of Commerce Hall, Waterbury, Conn.; **November 9**—Baltimore Section at the Engineers' Club, Baltimore, Md.; **November 14**—New Haven Section at Mason Laboratory, Yale University, New Haven, Conn.; **November 17**—Bridgeport Section at the Chamber of Commerce, Bridgeport, Conn., Toledo Section at the Toledo Commerce Club, Toledo, Ohio, and Worcester Section at Worcester, Mass.; **November 21**—Chicago Section—joint meeting with the Western Engineering Society at the headquarters of that society; **November 22**—Atlanta Section at Atlanta, Ga., and Philadelphia Section at the Roof Garden of the Adelphia Hotel, Philadelphia, Pa.; **November 25**—Colorado Section at the Metropole Hotel, Denver, Col.; **November 28-29**—Kansas City Section at Kansas City, Mo.

NEW BOOKS AND PAMPHLETS

The Working of Steel. By Fred H. Colvin and K. A. Juthe. 245 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $3.

This book contains a discussion of the annealing, heat-treating, and hardening of carbon and alloy steel. It describes approved methods of working the various kinds of steel now in commercial use. As is well known, the automotive field has done much to develop new alloys and methods of working them, and this field has been drawn on liberally by the authors to show the best practice. The practice in government arsenals on steels used in firearms is also described. The book contains twelve chapters having the following headings: Steel Making; Composition and Properties of Steels; Alloys and their Effect upon Steel; Application of "Liberty" Engine Materials to the Automotive Industry; the Forging of Steel; Annealing; Casehardening or Surface-carburizing; Heat-treatment of Steel; Hardening Carbon Steel for Tools; High-speed Steel; Furnaces; and Pyrometry and Pyrometers.

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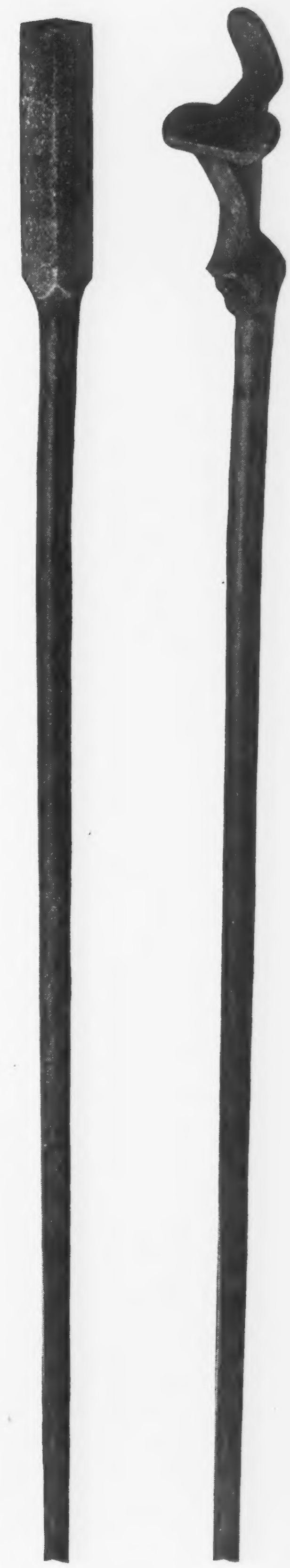
Draws Taper on 1400 Fender Irons in 8 Hour Day



Ajax Forging Rolls draw these tapered round shanks 20-in. long on fender irons at an average rate of 1400 per 8 hour day.

The stock used is 7/8-in. square cut in blanks 11 3/4-in. long. The shank 20-in. long, tapering from 5/8-in. round to 1/2-in. round, is drawn in the rolls leaving a block of square stock from which the foot is drop forged.

The output from the rolls is considerably higher than was obtained from other methods. The uniform taper and smooth surface make the quality highly satisfactory.

A great variety of straight drawn and tapered pieces is made most efficiently and economically on Ajax Forging Rolls. From blue prints of your forgings Ajax engineers can determine their adaptability for production by the Forging Roll Method.

The Ajax Manufacturing Co.

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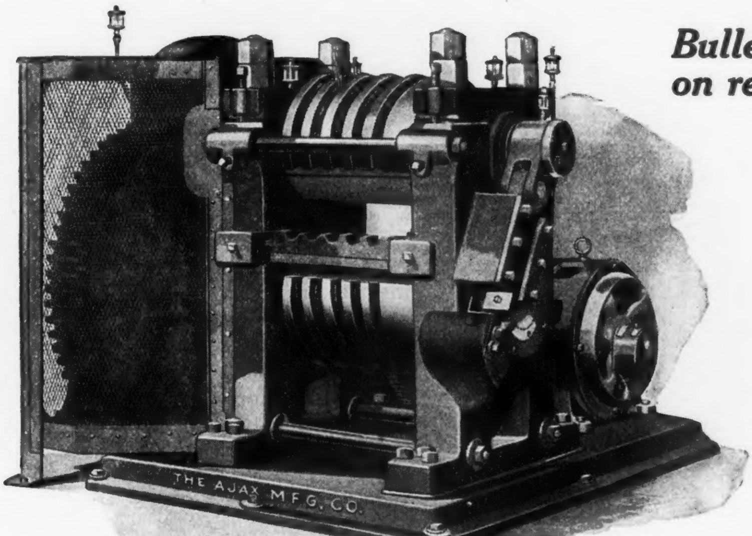

Centrifugal Pumps. By J. W. Cameron. 142 pages, 5½ by 8½ inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City, and Scott, Greenwood & Son, 8 Broadway, Ludgate, E. C. 4, London, England. Price, $3.75.

The development of the electric motor and the steam turbine has led to a tendency in present-day practice to substitute rotary for reciprocating machinery, and the author of this work believes that the time is not far distant when the centrifugal or turbine pump will displace the reciprocating type of pump. The book deals with the theory, action, and design of centrifugal pumps, and contains considerable formula matter for making the necessary calculations in design. It is intended to be used by engineers, draftsmen, and students who have a knowledge of the elementary principles of hydraulics. The examples on the design of centrifugal pumps illustrate the method used by the author in fixing upon the principal dimensions of this type of pump, and may serve as a guide to the young designer. The book contains twelve chapters headed as follows: Action and Advantages of Centrifugal or Turbine Pumps; The Theory of the Centrifugal Pump; Hydraulic Losses during the Passage of Fluid through Pump; Manometric Head, Change of Pressure, and Hydraulic Efficiency of Centrifugal Pumps; Bearings, Disk Friction; Effect of Angle at Discharge on the Efficiency of a Centrifugal Pump; Details of Centrifugal Pump; Axial Thrust and its Balancing; Calculation and Design of a Single-stage Pump; Calculation and Design of Multi-stage Pumps; Types of Pumps; and Testing.

NEW CATALOGUES AND CIRCULARS

Electrical Alloy Co., Morristown, N. J., Circular advertising "Magno" ignition metal, especially suitable for spark plug electrodes.

New Departure Mfg. Co., Bristol, Conn. Looseleaf data sheets, 137 and 138 FE, showing the application of ball bearings to motor-driven grinders, and "Sirocco" blowers.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Circular 2038, illustrating and describing the Type 9604 automatic starter for small alternating-current motors, which is equipped with mercury type overload relays, enclosed in a safety case.

Armington Engineering Co., Wickliffe, Ohio. Catalogue containing illustrations, specifications, and price lists for Armington hand-power hoisting equipment, including I-beam trolleys, flat-rail trolleys, hand-power hoists, and jib and traveling cranes.

Northern Engineering Works, Detroit, Mich. Bulletin 517, containing illustrations showing the application of Northern electric traveling cranes in foundry service, where the enclosed features and strong design of the trolley are particularly valuable features.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating Cleveland punches and shears and some of their products. The illustration of an aisle in the emergency stockroom of the company gives an idea of the large quantity of small tools carried in stock.

Union Switch & Signal Co., Swissvale, Pa. Booklet entitled "What is a Drop-forging?" containing general information relating to the drop-forging process and methods, as well as characteristics of drop-forgings. The booklet contains several pages of illustrations, picturing typical drop-forgings made by this company.

Geometric Tool Co., New Haven, Conn. Circular descriptive of the Jarvis friction tapping device, which is equipped with a cone friction drive, designed to prevent the breakage of taps when tapping holes in tough metal. Circular describing the features of the Geometric solid adjustable tap for machine and hand tapping.

Cincinnati Lathe & Tool Co., Oakley, Cincinnati, Ohio. Circular entitled "Guaranteed Service at a Fair Price with Cincinnati Lathes," containing illustrations and descriptions of the different types of lathes made by this company which include cone type and geared-head lathes in 16-, 18-, 20-, 22-, 24-, 26-, and 28-inch sizes.

Smalley-General Co., Inc., Bay City, Mich. Circular containing a number of time studies showing the time required for producing six different parts on the Smalley-General No. 23 thread milling machine. A time study is also given of the threading of a rotary tool joint by the use of the adjustable taper attachment supplied with the No. 23 machine.

Kinite Co., 1338 St. Paul Ave., Milwaukee, Wis. Booklet illustrating and describing the use of "Kinite" for shear blades, redrawing tools, blanking dies, drawing dies, embossing and forming dies, broaches, etc. Examples of increases in the number of pieces that may be produced per each dressing of the tool when this alloy steel is employed are given.

Pawling & Harnischfeger Co., 38th and National Aves., Milwaukee, Wis. Bulletin 56X, illustrating and describing P & H excavating equipment. Records are given of the actual performance of P & H excavators under a wide diversity of service in different sections of the country. Copies will be sent to anyone interested in this class of machinery.

National Safety Council, 168 N. Michigan Ave., Chicago, Ill. Safety calendar for 1922, containing on each sheet the calendar for the current month and a cartoon showing common dangers in the industrial world, and the results of ignoring the necessary precautions. The calendar is available to manufacturers in quantities at a nominal cost, by application to the National Safety Council.

Ingersoll Milling Machine Co., Rockford, Ill. Bulletin 41, containing a brief description and illustrations of Ingersoll drum type continuous milling machines. The possibilities of this type of machine are clearly indicated by the illustrations showing some of the different classes of work for which these machines are adapted, and the production figures which are given for each job.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 234, discussing the continuous heat-treatment of metals with automatic and semi-automatic furnaces. This pamphlet is the fourth of a series dealing with fundamentals influencing the quality and cost of heated products. The illustrations show various types of Rockwell furnaces for heat-treating, hardening, tempering, and annealing.

Cleveland Automatic Machine Co., Cleveland, Ohio. Loose-leaf catalogue, 9 by 12 inches, entitled "Production by Users of 'Clevelands'" containing reprints of articles descriptive of Cleveland automatics, previously published in MACHINERY, as well as reprints of advertisements showing the high rates of production which have actually been attained with these machines on various classes of work.

Sharon Pressed Steel Co., Sharon, Pa. Circular containing illustrations, general specifications, and description of the Sharon "Bluenose" all-steel truck, which is made in two sizes with lengths of 54 and 64½ inches. Circular containing specifications for the Sharon "Brute" all-steel trailer, which is also made in two sizes—46 by 60 inches and 42 by 60 inches—with capacity for carrying 6000 pounds.

Timken Roller Bearing Co., Canton, Ohio, is issuing a publication known as "The Timken Engineering Journal," which contains general information on the selection, fitting practices, adjustments, tolerances, enclosures, and use of Timken roller bearings on machinery and industrial appliances. It is the intention to issue different editions covering specific fields of application, which will be furnished upon request.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 239, descriptive of the "Economizer" shield type of forge furnace, designed to meet the demand for equipment which will lower production costs. The features to which especial attention is called are the means for better application of heat, protection of the operator, utilization of waste gases to preheat air and fuel for combustion, and the close grouping of furnaces made possible by the comparatively cool working end.

Smith & Serrell, Central Ave. at Halsey St., Newark, N. J. Bulletin 32, containing data on Francke flexible couplings for direct-connected machines. In addition to a general description of these couplings, directions are given for selecting the correct size of coupling for different classes of machines, as well as information on the installation of direct-connected machinery. Particular attention is called to the new light-duty type of flexible coupling for use with small light-duty motors up to from 50 to 75 horsepower.

Supreme Machine & Tool Co., Cleveland, Ohio. Bulletin AC-3, containing a detailed description of the "Supreme" universal boring, milling and drilling attachment, which is designed to meet the need for a jig boring machine that will eliminate the slow and costly process of figuring angles and sines. Instructions are given for the use of the chart, with which the attachment is equipped, by means of which the exact movement of the dividing gears may be determined for setting the boring head at the required angle.

Oakley Chemical Co., 26 Thames St., New York City. Booklet 1042, entitled "Modern Cutting and Grinding," containing information on cutting and grinding compounds and their relation to production. The application of "Oakite" compounds is described, and formulas for Oakite cutting and grinding compounds are given. Suggestions relating to the best practice in metal cutting and grinding are included, as well as tables of cutting and grinding speeds, tap drill sizes, and other useful data. Copies will be sent free upon request.

Metals Coating Co. of America, 495 N. Third St., Philadelphia, Pa. Booklet entitled "The Schoop Metal Spraying Process," containing a detailed description of this process of metal spraying, by means of which metallic coatings of any kind may be sprayed on all kinds of surfaces. The equipment used in connection with the process is also illustrated and described. The process may be applied for five different purposes as follows: Protective coatings, bonding or junction coatings, electrical coatings, decorative coatings, and detachable coatings.

Williams Tool Corporation, Erie, Pa. Booklet entitled "Don't Let it Happen to You," written for the purpose of instructing operators of power pipe machines in producing better threads and securing greater production. Considerable general information is given which is applicable not only to the machines made by this concern but also to other types of pipe machines. The principles of correct pipe threading are discussed, such points being considered as proper alignment of pipe and dies, proper lip, chip space, clearance, number of chasers, etc., and instructions are given relative to the care and use of dies. At the end of the book illustrations are shown of two styles of Williams pipe threading machines, which are built in eight sizes with capacities ranging from ¼ inch to 16 inches. Copies of this booklet will be sent upon request.

TRADE NOTES

Lovejoy Tool Co., Inc., Springfield, Vt., manufacturer of metal-cutting tools, announces that on October 10 a 25 per cent reduction was made on the list price of high-speed steel inserted cutters for Lovejoy holders.

Kearney & Trecker Corporation, Milwaukee, Wis., announces that the New York branch office of the company is now located at Room 371, Hudson Terminal Bldg., 50 Church St., having been moved on October 1 to this location from 1801 Singer Bldg.

Austin Machinery Corporation, Chicago, Ill., announces that Canadian Austin Machinery, Ltd., of Woodstock, Ontario, Canada, will henceforth act as sole manufacturer and distributor in Canada of the complete Austin line of earth-moving and concrete-mixing equipment.

Wilmarth & Morman Co., 1180 Monroe Ave., N. W., Grand Rapids, Mich., manufacturer of grinding machinery, announces that it has issued revised price lists of its products, effective October 1, which represent pronounced reductions in the prices of the different styles of grinding machines.

Metals Coating Co. of America, 495 N. Third St., Philadelphia, Pa., manufacturer and distributor of the Schoop metal spraying process, announces that it is now in full operation at its new plant in Philadelphia, to which it has recently removed from its former locations in Boston and Woonsocket.

Heppenstall Forge Co., Bridgeport, Conn., announces that it is changing all the heating furnaces in its forge department from the coal to the oil-fired type, because of the satisfactory experience it has had with furnaces of the latter type. The machine shop of the company is working single time, and preparations are being made for putting the forge shop on a schedule of two or three days a week.

Fay & Scott, Dexter, Me., manufacturers of lathes, announce that their plant started operation on full time on October 3, with a fifty-two-hour weekly schedule, this being the first time for nine months that the plant has been operated on full time. With the present slight upward trend in business the company hopes to maintain this schedule with its present force of approximately 100 men, which represents one-fourth the normal force.

Chain Belt Co., Milwaukee, Wis., has opened offices at 735 Ellicott Square, Buffalo, N. Y., and has announced the appointment of T. E. Cocker as district manager of that territory. Mr. Cocker will handle the "Rex" line, including chain, sprocket wheels, traveling water screens, elevators and conveyors. For the last five years Mr. Cocker has been handling elevating and conveying equipment. He is a civil engineer, having graduated from the Rensselaer Polytechnic Institute in 1907. From 1907 to 1917 he was connected with the New York Central Railroad at Buffalo, and at the time he left this company was assistant engineer.

L. C. Biglow & Co., Inc., 232 W. 55th St., New York City, have been appointed New York district agents for the Hartford Tap & Gauge Co., the Hanson-Whitney Machine Co., Inc., the Taylor & Fenn Co., and the Whitney Mfg. Co., all of Hartford, Conn. L. C. Biglow & Co., as agents for these companies, will handle taps of all kinds, finished after hardening to correct lead, pitch, and outside diameter; plug thread gages; bore grinding machines; two-spindle automatic spline-milling machines; sensitive drilling machines; vertical die-shaping machines; centering machines; automatic thread-milling machines; roller, block and silent types of chain; and Woodruff keys.

Central Steel Co., Massillon, Ohio, announces the consolidation and merger of that company with the Massillon Rolling Mill Co. and the National Pressed Steel Co., also of Massillon. The new corporation will take the name of the Central Steel Co., and the other two companies will be operated, respectively, as the Massillon Rolling Mill Division, and the National Pressed Steel Division, of the Central Steel Co. The officers of the company are as follows: President and chairman of the board of directors, R. E. Bebb; first vice-president, F. J. Griffiths; second vice-president, C. C. Chase; third vice-president, H. M. Naugle; and secretary and treasurer, C. E. Stuart. The combined companies will have facilities for making all kinds of commercial alloy steels, hot- and cold-rolled sheets, hot-rolled strip steel, and light structural steel sections, with a capacity for producing 450,000 to 475,000 tons of finished material annually.